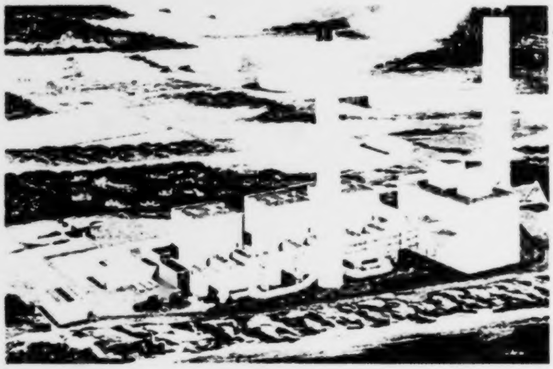
Coleson Cove Generating Station
Refurbishment Project
Environmental Impact Assessment
Final Report

June 2002



Énergie NB Power

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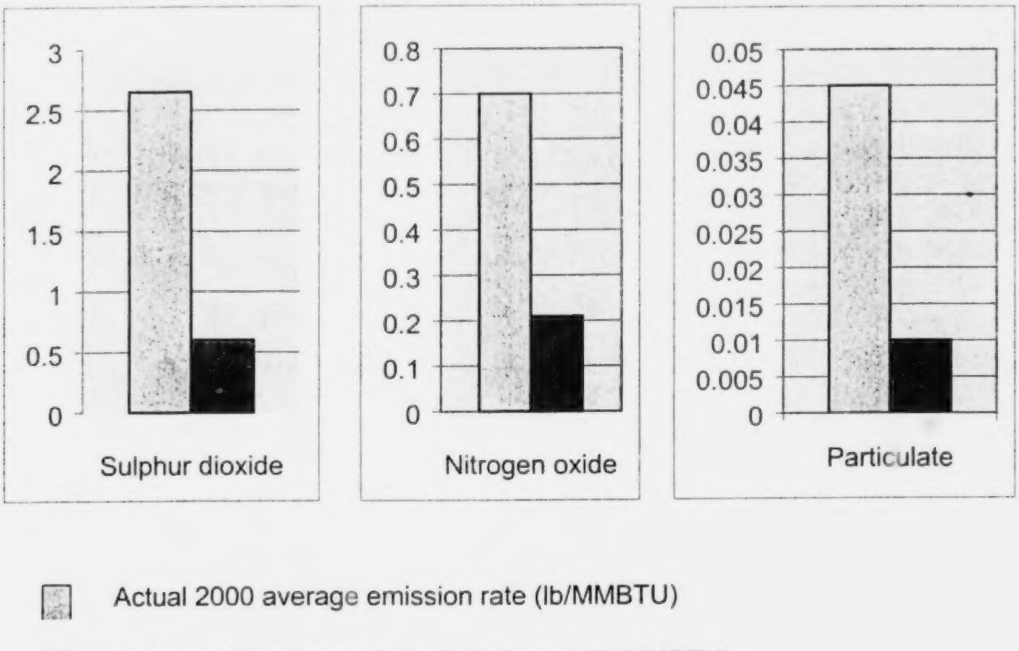
EXECUTIVE SUMMARY

Introduction

NB Power proposes to refurbish the Coleson Cove Generating Station (CCGS), which is the largest source of electrical generation in New Brunswick and has operated since 1976 using Fuel Oil #6. The Coleson Cove Refurbishment Project (the Project) will primarily involve the installation of extensive emission control equipment, and the conversion to Orimulsion® fuel. The Project will reduce emissions, stabilize electricity rates and ensure a reliable source of energy for the province.

The Project will realize major reductions in emission rates. These rates will be reduced by approximately 77% for sulphur dioxide (SO_2); 70% for nitrogen oxides (NOx); and 75% for particulate matter, as shown in the diagrams below.



The Project was registered with the New Brunswick Department of Environment and Local Government (NBDELG) on July 25, 2001. On October 31, 2001, the Minister of NBDELG directed that a full environmental assessment be undertaken. This Environmental Assessment (EA) report is submitted in response to that directive, and in accordance with Final Guidelines issued by NBDELG on January 15, 2002 and the Terms of Reference prepared by NB Power and dated February 26, 2002.

This EA report provides detailed descriptions of the existing CCGS, Orimulsion® fuel, the Project, emissions reductions, Project Alternatives - including alternative fuels and fuel delivery systems, the Environmental Setting, and the specific geographical area identified for in-depth study. The report also describes, in detail, the EA process and the detailed methodology employed to assess future impacts, related to construction, operation and decommissioning of the Project.

The EA report concludes that there are no significant adverse environmental effects resulting from the Project. Indeed, it is predicted that there will be positive effects on air quality, as well as the local and provincial economies. In addition, there will be reduced risk for the Bay of Fundy marine environment, and human health in the study area.

Component Studies

The conduct of the EA has involved the preparation of detailed technical reports, or "Component Studies" on specific issues and concerns. Substantial descriptive information and key findings from each of these Component Studies has been incorporated into this EA report. These Component Studies have been issued under separate cover to the NBDELG, and include:

- Air Quality Study – Dispersion Modelling Assessment
- Environmental Background Study – Solid Waste Storage and Disposal Area
- Surface Water Supply Study
- Fuel Delivery System Study
- Socio-economic Study - Benefits to the Local and Provincial Economies of the Coleson Cove Plant Upgrades
- Transportation Study
- Comparative Ecological Risk Assessment
- Human Health Risk Study
- Supplemental Studies

Consultation

Since May 2001, NB Power has conducted extensive public and stakeholder consultation related to the Project. Public information sessions were held in Saint John, Lorneville, and Musquash in May and June 2001. In the autumn of 2001, NB Power hosted two workshops on important issues related to the design of the EA study. These workshops focused on developing conceptual models for identifying Valued Environmental Components (VECs) and potential scenarios for a marine-based spill involving either Orimulsion®, or Fuel Oil #6. Over the period October 2001 to March 2002, NB Power organized and hosted several information sessions with the public and key interest groups, municipalities, business organizations, the Fundy North Fisherman's Association, Saint John Citizens Coalition for Clean Air, the City of Saint John Environment Committee and the Conservation Council of New Brunswick. To date, approximately twenty-five meetings have been held with more than 500 participants. NB Power intends to actively communicate with the public and stakeholders as the EA process evolves.

Project Background/Rationale

The Government of Canada and the New England Governors and Eastern Canadian Premiers are working co-operatively to achieve regional and national reductions in total SO_2 emissions and in addition have commenced the development of NOx reduction plans. Though no timeframe has been finalized, emission reduction implementation for sulphur dioxide is expected by 2010 or earlier.

The NBDELG has indicated that it is expecting a two-phase reduction in the province's existing annual sulphur dioxide limit. Phase 1 will comprise a 30% reduction by 2005, and Phase 2 will comprise a 50% reduction by 2010. The Project will contribute toward the achievement of these objectives by equal or greater percentages.

The Certificate of Approval to Operate the CCGS issued by NBDELG in January 2000, required NB Power to file a sulphur dioxide emissions reduction plan outlining a proposed approach to achieving a target for this facility not to exceed 40,000 tonnes per year. This reduction plan was submitted as a report, "NB Power's Sulphur Dioxide Emissions Reduction Program – January 2001".

The Sulphur Dioxide Emissions Reduction Program sets out specific actions that satisfy potential SO_2 emissions constraints. To meet these potential regulatory requirements, NB Power's planned reduction program consists of the following main elements:

- retirement of the Grand Lake Generating Station (the station uses 6-8% sulphur coal);
- refurbishment of the Point Lepreau Generating Station;
- operation of existing flue gas desulphurization equipment at the Dalhousie and Belledune Generating Stations;
- utilization of low sulphur fuel in combustion turbine units; and
- installation of flue gas desulphurization to control sulphur dioxide emissions, a reburn combustion system to control nitrogen oxide emissions, and a wet electrostatic precipitator to control sulphur trioxide emissions at the CCGS, coupled with refurbishment of the existing dry electrostatic precipitators, and conversion from Fuel Oil #6 to Orimulsion®.

In addition to the Province setting new emission caps for sulphur dioxide, the federal government has developed ambient air quality standards for ozone and particulate matter, and new standards are expected for nitrogen oxides and mercury.

The Project is an essential element in provincial and NB Power plans to control future sulphur dioxide and nitrogen oxide emissions. Although other technical options for meeting the same emission reduction objectives have been considered (including the use of natural gas), the analysis shows that refurbishment and conversion to Orimulsion® is the lowest cost option, with least impacts on the ratepayers of New Brunswick.

Conclusions

The conclusions described in the EA report address issues in a manner consistent with the Final Guidelines (NBDELG, 2002) as well as the Terms of Reference (NB Power, 2002). The following conclusions present residual environmental effects that are anticipated to be present following application of identified mitigation.

- Air Quality - There will be a major reduction in emissions, which will result in improved air quality in the airshed. No significant adverse environmental effects are likely.
- Surface and Groundwater - These resources will be protected through application of construction practices designed to mitigate any identified concerns. No significant adverse environmental effects are likely.
- Bay of Fundy - There will be an overall positive effect due to reduced risk relative to the current situation, as there is a lower probability and a demonstrated lower consequence of an accidental fuel spill. No significant adverse environmental effects are likely.
- Transportation - Mitigation is required to reduce congestion at one specific location during the construction period. No significant adverse environmental effects are likely.
- Economy and Culture - There will be an overall major positive effect on the local and provincial economies during construction and operation. The Project is compatible with New Brunswick *Energy Policy*. Measures will be in place to protect workers during construction and operation. No significant adverse environmental effects are likely.
- Human health risks - The reductions in emissions of respirable particulate matter and other criteria pollutants associated with this Project are a public health benefit. No significant adverse environmental effects are likely.
- Terrestrial, Wetland and Freshwater - Mitigation will be applied to ensure protection of these important resources both during construction and operation of the Project. No significant adverse environmental effects are likely.
- Surface Water Supply - The Spruce Lake water supply system has sufficient capacity to meet the requirements of the Project, therefore, no significant adverse environmental effects are likely.
- Effects of the Environment on the Project - Effects of extreme conditions on the Project were considered including effects of climate change. No significant adverse environmental effects are likely.

A summary of the Valued Environmental Components including potential impacts and mitigation is provided below and also in Appendix A.

The cumulative effect of the Project has been considered for each Valued Environmental Component. Based on the residual effects predictions made in the effects assessments of each VEC, there are no cases where it is necessary to consider the cumulative effects of the Project in combination with other projects.

Valued Environmental Components

V EC	Potential Impacts	Mitigation	Report Section
Air Quality	Air emissions due to the CCGS operation and traffic related to limestone/gypsum transportation and maintenance. Air emissions due to construction traffic.	Installation of additional emission reduction equipment at the CCGS including: I. Flue gas desulphuization system; II. Wet electrostatic precipitator; and III. A reburn combustion system.	Sections 4.3.2 and 7.2
Marine Ecosystem	Potential Spills of Orimulsion® in the Bay of Fundy may affect marine resources, species potentially at risk, marine mammals, shorebirds, fisheries and aquaculture, and areas for human recreation and/or historic significance (e.g. shipwrecks).	Orimulsion® vessel suppliers required to follow Bitor's corporate commitments related to fuel shipment Vessels meet or exceed international standards (i.e., MacKenzie Rating System) Only double-hulled vessels under 15 years old will be used for deliveries of Orimulsion® Officers selected for Orimulsion® tankers must speak both English and the mother tongue of the predominant crew nationality	Section 7.3
Terrestrial and Freshwater Ecosystem	Disturbance of fish or fish habitat, wetlands, species at risk, and terrestrial habitat including migratory birds as follows: i. Disturbance effects during construction for new pipeline sections; ii. Disturbance effects during operations and maintenance from new and existing pipelines (including accidental spills); iii. Surface water quality near the SWSDA during operations; iv. Groundwater quality adjacent to the SWSDA site during construction, operations, decommissioning;	Use Horizontal Directional Drilling (HDD) for wetland and watercourse crossings during pipeline construction or/and environmentally acceptable alternative. Withdraw hydrostatic test water from municipal sources and return to a municipal or industrial water treatment system. Design and implement a monitoring program to ensure sediment and erosion control measures are functioning properly. Provide education on environmental protection for workforce. Application of the generic New Brunswick Solid Waste Landfill Design criteria during construction of the proposed landfill. Conduct clearing activities outside of the nesting season (i.e., avoid May 1 to August 1). Avoid construction activities within riparian zones.	Section 7.4

Valued Environmental Components

V EC	Potential Impacts	Mitigation	Report Section
	v. Water quality and habitat disruption at water body crossings during construction of new pipeline sections, and during operation and maintenance of new and existing pipelines.	Develop site specific environmental protection plans where required. If wood turtles are encountered during clearing or construction, remove from the work area and place in the forest adjacent to a watercourse. Continue monitoring and maintenance of existing pipeline.	
Human Health and Safety	Community Health effects during operation and maintenance from airborne and deposited substances. Safety, congestion, noise effects on community from traffic during construction and operation and maintenance. Worker health and safety during construction and operations.	Reduce the air emission levels and maintain levels at or below existing Provincial guidelines. Restrict truck traffic during night time hours and reduce use of jake brakes. Install temporary signal lights at the intersection of the westbound Route 1 ramps with Ocean West Way/King William Road, at least during the peak six month period of construction. Enforce Provincial health and safety Acts and regulations, as well as NB Power's Health and Safety Policy.	Section 7.6 Section 7.5.5 and 7.6.5 Section 7.5.2
Economy and Culture	Economic and employment changes due to construction and operations.	None required.	Section 7.5.1
	Damage to archaeological resources during construction of the pipeline and the solid waste storage and disposal area.	Pre-construction field survey of areas with an elevated potential for archaeological resources. Develop protocol outlining required action in the event of archaeological\heritage resource discovery.	Section 7.5.4
Sustainability Assurance	Effects on ecosystem including rare and endangered species/communities by construction or operations. Cumulative effects including production of CO_2 and other greenhouse gases, acid rain, and harmful air emissions.	Refer to measures listed above for Marine Ecosystem and Terrestrial and Freshwater Ecosystem. Implementation of Environmental Management System Program based on ISO 14000 standards and adherence to all Provincial and Federal Guidelines for air emissions.	Sections 7.3 and 7.4 Section 7.7 Section 7.9
Environment on the CCGS	Severe weather and shoreline erosion may affect facility lifespan or operation. Short interruptions in sea-borne fuel delivery.	Existing and future facilities have been/will be designed to approved industry standards. Provide fuel storage for short term operations	Section 7.8

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GLOSSARY

ablation till	till deposited by the combined process by which glaciers retreat/melt.
acidic	pH below 7.0.
aesthetic	of or pertaining to beauty.
AMEC	AMEC Earth & Environmental Limited.
alluvial	sediments deposited in rivers.
alternative routes	refers to routes that have been identified on the basis of constraint mapping, stakeholder consultation, impact assessment and other factors.
anadromous	used to describe fish that spawn in freshwater after spending most of their life in the sea (i.e., species with a saltwater growing phase and a freshwater reproductive phase).
anthropogenic	derived or resulting from human activity.
aquifer	any geologic unit capable of supplying a significant amount of water.
archaeological resource	pre-contact and/or historical artifacts, archaeological features or sites.
archaeological site	an area where one or more archaeological resources have been identified.
archaeological survey	the archaeological investigation of an area for evidence of cultural activity.
artifact	any object made or altered by human activity.
aromatic hydrocarbon	a chemical compound consisting entirely of carbon and hydrogen in a specific structure.
baroclinic	descriptive of an atmosphere or ocean in which surface pressure and density intersect at some level or levels.
bedrock	the more or less solid rock in place either at or beneath the surface of the earth.
benzene	(C_6H_6) a colorless, flammable liquid aromatic hydrocarbon.
brackish	salty.
British Thermal Unit	a measure of heating value of fuel.

GLOSSARY

BTEX	Abbreviation for the total of benzene, toluene, ethylebenzene and xylenes contained in fuel; and, of interest because of their acute and chronic toxicity when released into an aquatic environment.
cadmium	A chemical element, symbol Cd, atomic number 48, atomic weight 112.4; a thin-white, malleable, ductile metal capable of high polish; principal use is in the plating of iron and steel, and to much less extent of copper, brass, and other alloys to protect them from corrosion.
cathodic protection	a method of preventing corrosion to a metal surface by causing the surface to act as the cathode of an electrochemical cell.
cathodic protection	protecting a metal from electrochemical (galvanic) corrosion by one of two methods: sacrificial anode or impressed current.
CEAA	*Canadian Environmental Assessment Act*. Administered by the Canadian Environmental Assessment Agency (the Agency).
certificate of approval	approval that is issued, amended or renewed by the New Brunswick Department of Environment and Local Government under a specific Regulation.
condensate	water created by cooling steam or water vapor.
condensate polishing	the use of a cation resin or mixed bed unit to remove impurities from condensate.
coriolis force	a force that is due to the Earth's rotation.
cultural landscape	the physical and cultural environment associated with a heritage site.
dBA	a commonly used sound measurement that approximates the response of the human ear to sound. A 10 dBA increase represents a doubling of the noise level, a 10 dBA decrease results in a halving of the noise level.
decommissioning	preparing facilities for abandonment at the end of project life.
deposition	in the context of "sediment deposition," meaning the accumulation of material which settles or is dropped due to slower movement of the transporting agent, water.

GLOSSARY

designated archaeological/heritage site/structure	a structure or site given special status under one or more government inventories.
discharge	in the context of "water flow," meaning the process by which groundwater feeds into surface water bodies, or the general flow of water from a source to a receiving body of water.
diversity	in the context of "species diversity," meaning an expression of the number of different species in a sample or study area indexed according to the number of individuals of each species.
drainage area	all land and water area from which runoff may contribute to a common point (watershed).
drainage	the removal of excess surface water or groundwater from land by means of surface or subsurface drains.
dry electrostatic precipitator	an electrical mechanism (or method) used to separate suspended particles from a gas stream.
earthquake	perceptible trembling to violent shaking of the ground, produced by the sudden displacement of rocks below the earth's surface.
ecosystem	the combination of the biological (biotic) community and the non-living (abiotic) environment.
edge habitat	areas where two habitat types meet (e.g., forest-field; water-shore).
effluents	liquid waste discharges.
embankment	fill constructed with soil materials to contain water.
emergent vegetation	aquatic vegetation which reaches above the surface of the water.
endangered	descriptive of a species threatened with imminent extinction or extirpation.
endemic	peculiar to a particular region or locality.
erodible	susceptible to erosion.
erosion	detachment of soil particles by agents such as water, wind, ice and gravity.

GLOSSARY

ethylebenzene	$C_6H_5C_2H_5$ a colorless, liquid aromatic hydrocarbon.
extinct	a species that no longer exists on the planet.
extirpated	a species that no longer exists in a specific location, but is found elsewhere.
fauna	animals.
fish habitat	the spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes (federal definition).
flocculation	A process that lumps or masses.
flora	plants.
fly ash	by-product of thermal electric generating plants resulting from the combustion of coal, oil or Orimulsion® which is transported from the firebox through the boiler by flue gases.
fugitive emission	a gas, liquid, solid, vapour, fume, mist, fog, or dust that escapes from process equipment, or work areas.
glacial till	non-sorted, non-stratified sediment carried or deposited by glaciation.
glaciofluvial	pertaining to watercourses flowing from glaciers or to material deposited by their flow.
grading	any RoW stripping, cutting, filling, stockpiling, or any combination thereof, including the land in its cut-and-filled condition.
gravel	rounded rock or mineral pieces larger than two mm in diameter (i.e., an accumulation of pebble, cobbles, or combinations of these).
greenhouse gases	greenhouse gases, such as water vapor, carbon dioxide, nitrous oxide and methane, that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving the Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.
ground level ozone	ozone concentrations at ground level.

GLOSSARY

habitat	the environment in which the life-cycle requirements of a plant or animal are supplied.
hazard index	the ratio of the average daily dose estimated by the health risk assessment to the Tolerable Daily Intake derived by governmental health authorities from toxicology studies by the application of safety factors typically ranging from 100-1,000 from No Observed Adverse Effect Levels.
hazardous materials	any prohibited, restricted, or controlled product.
herbivore	a species whose diet consists of plant matter.
heritage constraint	constraint to development due to the existence of a heritage resource.
heritage potential	pertains to the estimated level of potential an area holds to contain heritage resources based on an understanding of the region's past and present landscape uses and environment.
heritage resources	a term referring to archaeological resources/sites, heritage structures, designated historic sites, sensitive sites, burial sites, and areas of historical importance.
heritage structure	standing structure meeting Canadian Inventory of Historic Building (CIHB) criteria and identified in a government inventory.
herpetiles	a category of animal consisting of amphibians and reptiles.
high margin export	In context, export power with the high difference between selling price and cost (operating profit).
historic	an area recognized and inventoried for its heritage value.
hydrography	the scientific description and analysis of the physical conditions, boundaries, flow and related characteristics of the Earth's surface waters.
hydrology	the scientific study of the properties, distribution, and effects of water on the Earth's surface, in the soil, and underlying rocks.
hydroseeding	application of a mixture of seed, fertilizer, mulch, binder, and water on for slopes, backslopes, ditches, and other prepared areas to produce a uniform cover of vegetation.

GLOSSARY

igneous rock	rock formed by solidification from a molten or partially molten state (volcanic in origin).
impact	an observable and measurable response of a population, individual or abiotic factor to an external source of disturbance (synonymous with "effect").
infiltration	in the context of "groundwater," meaning liquid penetration through an area, such as water-borne pollutants moving through soil (e.g., saltwater intrusion).
intermodal	describes a move involving two or more carriers, using different modes of transport from each other.
intertidally	the shore zone between the mean low water and the mean high water mark. The substrate is exposed and flooded by tides.
invertebrate	an animal lacking a backbone or bony skeleton.
leachate	water that collects contaminants.
lichen	an association of two species consisting of a fungus living symbiotically with an algae.
littoral	a coastal region; a shore.
low margin export	In context, export power with the low difference between selling price and cost of production (operating profit).
macrophytic	of macroscopic plants.
methane	(CH_4) a flammable, colorless, odorless, tasteless gas that is formed by decaying organic matter.
migration (fish)	movement of fish, usually in large numbers, with the purpose of reaching areas used for spawning.
monobuoy	a deepwater floating facility designed and best suited to unload large tankers.
mysiteceti	large whales with whalebone plates instead of teeth.
mitigation measures	measures applied to eliminate or minimize the potential adverse effects of an activity on the environment (synonymous with mitigative measures).
MWh	megawatt per hour. The hourly unit of measure for electric power (1 MW = 1 000 000 W)

GLOSSARY

natural bitumen	portion of petroleum that exists in the semi-solid or solid phase in natural deposits. In its natural state it usually contains sulphur, metals and other non-hydrocarbons. Natural bitumen has a viscosity greater than 10 000 mPa.s measured at original temperature in the deposit and atmospheric pressure on a gas free basis.
natural gas	a mixture consisting predominantly of hydrocarbon gases, the more common of which are methane, ethane, propane, butanes, pentanes, hexanes and heptanes. Natural gas carried in transmission/distribution pipelines consists mainly of methane.
nickel	a metallic element having the symbol Ni, an atomic weight of 58.70, a melting point of 1455 °C and a boiling point of 2900 °C.
odontoceti	toothed whales.
opacity	a measure of the degree to which emissions reduce the transmission of light and obscure the view of an object in the background
organism	any life form.
Orimulsion®	a liquid fuel formed from an emulsion of natural bitumen in freshwater, and a surfactant.
PAH	polycyclic aromatic hydrocarbons; hydrocarbon molecule with two or more closed rings.
paleontological	the study of life from fossil remains.
passerine	perching birds.
perennial	a plant which lives for more than two growing seasons.
petroleum product	includes aviation fuel, asphalt, bunker "C" oil, diesel fuel, engine oil, gasoline, kerosene, lubricants, mineral spirits, naphtha, petroleum-based solvents, transformer oil, and water/petroleum products (exclusive of paint and propane).
pH	a quantitative measure from 0 to 14 of the acidity or alkalinity of a solution. Low pH indicates acidity, high pH indicates alkalinity, pH7 indicates neutrality.
physiography	the shape and form of the landscape.
pig	a spherical or cylindrical device inserted in a pipe or pipeline to clean, clear or inspect the inside of the pipe.

GLOSSARY

podzol	a highly leached soil that is low in iron and lime.
post-contact	after the arrival of European groups, generally accepted as after 1604 in New Brunswick.
pre-contact	prior to arrival of European groups, generally accepted as before 1604 in New Brunswick.
raptors	birds of prey (e.g., hawks, owls, eagles).
rare species	species which occur in low numbers in a given area, but which are in little danger of extinction, but are likely to become vulnerable.
recharge	in the context of "groundwater," meaning the process by which water resulting from precipitation infiltrates into the groundwater table.
redispatch	In context, to replace lower cost higher CO_2 energy with higher cost lower CO_2 energy.
relief (physiographic)	the difference in elevation between the high and low points of a land surface.
resins	chemical adsorbent materials.
riparian zones	landscape features associated with water bodies such as lakes, rivers, streams, and wet areas, consisting of terrestrial and aquatic components that influence each other; the banks or shores of watercourses.
RoW	right-of-way, legal right of passage over another individual's parcel of land.
runoff	portion of the precipitation on a drainage area that is discharged from the area via watercourses. Includes surface runoff, groundwater runoff, or seepage.
sandstone	a sedimentary rock composed predominantly of sand-sized quartz grains.
sediment control fence	fence constructed of geotechnical fabric and installed in a special manner to collect sediments in surface runoff, and prevent sedimentation of watercourses.
sediment basin	a depression formed from the construction of a barrier or dam built to retain sediment or debris, and prevent sedimentation of watercourses.

GLOSSARY

sediment	fine soil material that is generated by erosion and deposited from water.
sedimentary rock	rock formed by the accumulation of sediment in water (aqueous deposits) or from air (eolian deposits).
sedimentation	deposition of soil particles or other solids into a watercourse.
seepage	water escaping through, or emerging from, the ground; usually considered to occur along an extensive line or surface, as contrasted with a spring, where the water emerges from a localized spot.
seismic	pertaining to, characteristic of, or produced by earthquakes or earth vibration, as seismic disturbances.
sensitive	descriptive of a species that normally exhibits a well-defined response to an external source of disturbance when measured under controlled conditions.
shale	a laminated sedimentary rock composed predominantly of clay-sized particles.
sheet erosion	soil erosion caused by sheet flow (overland flow), which is water flowing in a thin layer over the soil surface, as opposed to a concentrated flow.
silt	clastic material from 1/256 mm to 1/16 mm in diameter (i.e., fine sand).
siltation	see also sedimentation. Denotes sediment pollution of a watercourse.
siltstone	a sedimentary rock composed predominantly of silt-sized particles.
slate	a fine-grained metamorphic rock that originated as shale, easily split into flat smooth plates.
solvent	an organic liquid in which other organic materials (such as grease or oil) will dissolve (e.g., alcohol).
species	a self-perpetuating population of animals or plants which is more or less genetically isolated.
species at risk	species designated as either endangered, threatened, vulnerable or rare (i.e., by Federal and Provincial regulatory authorities or species experts).

GLOSSARY

stakeholder	interested party.
streambank	the usual boundaries, not the flood boundaries, of a stream channel.
streambed	the bottom of a channel, carrying streamflow.
subtidal	substrate that is continuously submerged.
sump	A containment that receives and temporarily stores drainage at the lowest point of a circulating or drainage system.
surface runoff	see runoff.
surface water	all water, the surface of which is exposed to the atmosphere.
surfactant	a substance capable of reducing the surface tension of a liquid in which it is dissolved.
surficial	in the context of "geology," meaning characteristic of, pertaining to, formed on, situated at, or occurring on the earth's surface; especially, consisting of unconsolidated residual, alluvial, or glacial deposits lying on the bedrock.
suspended sediments	sediment particles either floating or suspended in water.
thalweg	the line of greatest depth along the watercourse channel.
threatened	descriptive of a species likely to become endangered.
till	non-sorted, non-stratified sediment carried or deposited by a glacier.
topography	the configuration of the Earth's surface, including the shape, elevation and position of its natural and man-made features.
toluene	$C_6H_5CH_3$ a colorless, liquid aromatic hydrocarbon.
toxicity	the characteristic of being poisonous or harmful to plant or animal life; the relative degree or severity of this characteristic.
toxins	substances which are poisonous or harmful to plant or animal life.

GLOSSARY

trophic level	the position that an organism occupies on the food web (number of energy transfer steps needed to get to that level of the food web).
turbidity	condition of water when it becomes cloudy due to sediment in suspension.
ug/m^3	micro grams per cubic meter. Unit of measure for the concentration of a contaminant or constituant in a liquid or gas.
vanadium	a naturally occurring metallic element.
vantage	a position which provides an extensive view and strategic advantage.
vascular plant	any plant characterized by possession of water and sugar transporting tissue.
vulnerable	descriptive of a species at risk because of low numbers or restricted occurrence, and likely to become threatened.
watercourse	the full width and length, including the bed, banks, sides and shorelines, or any part of a river, creek, stream, spring, brook, lake, pond, reservoir, canal, ditch or other natural or artificial channel open to the atmosphere, the primary function of which is the conveyance or containment of water whether the flow be continuous or not (provincial definition).
watershed	an area of land draining to a common collection system such as stream or lake. See also, drainage area.
wetland	land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, wetlands vegetation, and various kinds of biological activity which are adapted to a wet environment. Includes bogs, fens, marshes, swamps, and shallow waters.
xylene	$C_6H_4(CH_3)_2$ a colorless, liquid aromatic hydrocarbon.

ACRONYMS

<	Less than
>	Greater than
AADT	Average Annual Daily Traffic
AC CDC	Atlantic Canada Conservation Data Centre
AE	Alcohol ethoxylates
Agreement	Standard Municipal Operating Agreement
AHCC	Atlantic Health Sciences Corporation
ALERT	Atlantic Emergency Response Team
API	American Petroleum Industry
ARD	Acid Rock Drainage
ARMA	Air Resource Management Area
ASU	Archaeological Services Unit of the Heritage Branch, Culture and Sport Secretariat
Bitor	Bitumenes de Orinoco, S.A.
BP	Before Present. For dating purposes, this means before A. D. 1950
BTEX	benzene, toluene, ethylbenzene, and xylene
BTU	British Thermal Unit
CA	Census Agglomeration
CCCMA	Canadian Centre for Climate Modelling and Analysis
CCG	Canadian Coast Guard
CCGS	Coleson Cove Generating Station
CCME	Canadian Council of Ministers of the Environment
CEA	Cumulative Effects Assessment
CEA	Canadian Electricity Association
CEAA	*Canadian Environmental Assessment Act*
CEMs	Continuous Emission Monitors
CERA	Comparative Ecological Risk Assessment
CIS	Close Interval Cathodic Survey
CLI	Canada Land Inventory
CMA	Census Metropolitan Area
CMHC	Canada Mortgage and Housing Corporation
CMS	Cubic Metres per second
CN	Canadian National Railway
CO	Carbon monoxide
CO_2	Carbon dioxide
COA	Certificate of Approval

ACRONYMS

COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CP	Cathodic Protection
CSA	Canadian Standards Association
CW	Cooling water
dBa	Decibel, Unit of Measure of Sound
DCS	Digital control system
DEA	Diethanolamine
DFO	Fisheries and Oceans Canada
DnV	Det norske Veritas
DU	Ducks Unlimited
DWA	Deer wintering area
DWT	Dead-weight tons
EA	Environmental Assessment
ECC	Environmental and Socio-economic Components of Concern
ECM	Environmental Compliance Monitoring
ECR	Environmental Commitment and Responsibility
EEM	Environmental Effects Monitoring
EHJV	Eastern Habitat Joint Venture
EMP	Environmental Management Program
EMS	Environmental Management System
EPA	Environmental Protection Agency
EPC	Emergency Preparedness Canada
EPM	Emergency Procedures Manual
EPP	Environmental Protection Plan
ESA	Environmentally Significant Area
FGD	Flue gas desulphurisation
FGR	Flue gas recirculation
GAC	Geographic Areas of Concerns
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GVM	Gross vehicle mass
GVRD	Greater Vancouver Regional District
H_2S	Hydrogen Sulphide
HADD	Harmful alteration, disruption or destruction (of fish habitat)
HDD	Horizontal directional drilling
HDDT	Heavy duty diesel truck
HFO	Heavy Fuel Oil

ACRONYMS

I.D.	Inside diameter
IACS	International Association of Classification Societies
IACS	International Association of Classification Societies
ILI	In line inspection
IMO	International Maritime Organziation
IOL	Irving Oil Limited
ISC	Industrial Source Complex
JHSC	Joint Health and Safety Committee
JWEL	Jacques Whitford Environment Limited
LC_{50}	Concentration which is toxic to 50% of the exposed population
LD	Lobster District
LNG	Liquified Natural Gas
MAOP	Maximum allowable operating pressure
MARPOL	International Convention for the Prevention of Pollution from Ships
MCTS	Marine Communications and Traffic Services
MEA	Monoethanolamine
MMBTU	Million British Thermal Unit
MOU	Memorandum of understanding
MSDS	Material Safety Data Sheets
MW	Megawatt
NAAQO	National Ambient Air Quality Objectives
NAFO	North Atlantic Fisheries Organization
NAPS	National Air Pollution Surveillance
NB	New Brunswick
NBCC	New Brunswick Community College
NBDAFA	New Brunswick Department of Agriculture, Fisheries, and Aquaculture
NBDEDTC	New Brunswick Department of Economic Development, Tourism and Culture
NBDELG	New Brunswick Department of Environment and Local Government
NBDNRE	New Brunswick Department of Natural Resources and Energy
NBDOT	New Brunswick Department of Transportation
NBEMO	New Brunswick Emergency Measures Organization
NEG/ECP	New England Governors and Eastern Canadian Premiers
NFPA	National Fire Protection Agency
NGO	Non-government organization

ACRONYMS

NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
NSA	Noise Sensitive Area
NTNBI	Nature Trust of New Brunswick Inc.
NTS	National Topographic Series
NWPA	*Navigable Waters Protection Act*
O.D.	Outside Diameter
O_3	Ozone
°C	Degrees Celsius
OSFH	Old Spruce and Fir Habitat
P&I	International Group of Pollution and Insurance
PAH	Polycyclic aromatic hydrocarbons
PDV S.A.	Petroleos de Venezela South America
PE	Polyethylene
PIRS	Pollution Incident Reporting System
PM	Particulate matter
PM_{10}	Inhalable particulate matter
$PM_{2.5}$	Respirable particulate matter
POL	Petroleum, oil, lubricant
ppb	Parts per billion
PSP	Permanent forest sample plot
PUB	Public Utilities Board
PVC	Polyvinyl chloride
ROC	Regional Operations Center
RoW	Right-of-Way
SAR	Search and Rescue
SARA	Sulphur, saturates, aromatics, resins and asphaltenes
SBM	Single Buoy Mooring
SCEM	Software Continuous Emission Monitoring
SCR	Selective Catalytic Reduction
SCS	Supplementary Control System
SJLPP	Saint John Lateral Pipeline Project
SO_2	Sulphur Dioxide
SO_3	Sulphur Trioxide
SOPF	Ship-source Oil Pollution Fund
SPA	Scallop Production Areas
SWSDA	Solid Waste Storage and Disposal Area

ACRONYMS

TCH	Trans Canada Highway
TDS	Total Dissolved Solids
TEA	Triethanolamine
TEOM	Tapered Element Oscillating Micro-Balance
TSP	Total Suspended Particulates
UNBSJ	University of New Brunswick Saint John
VEC	Valued Environmental Component
VFD	Variable frequency drives
VLCC	Very Large Crude Carrier
VOC	Volatile Organic Compound
VSC	Valued Socio-Economic Component
WESP	Wet Eletrostatic Precipitator
WGA	Washburn and Gillis Associates
WHMIS	Workplace Hazardous Materials Information System
WWTP	Wastewater Treatment Plant
μg	Microgram (10^{-6}g)
μm	Micron (10^{-6}m)

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1.0 INTRODUCTION

NB Power, a Crown Corporation operating under the jurisdiction of the Province of New Brunswick, operates the Coleson Cove Generating Station (CCGS), located near Lorneville, Saint John County, in southern New Brunswick. NB Power proposes to refurbish CCGS, which is the largest source of electrical generation in New Brunswick, and has operated since 1976, using Fuel Oil #6. This Environmental Assessment (EA) report has been prepared and is submitted as required under the Environmental Impact Assessment process of the Province.

Hereinafter in this EA report the Coleson Cove Refurbishment Project will be referred to as the "Project", the plant will be referred to as the CCGS, and the geographic location of the Project will be referred to as Coleson Cove.

This EA deals with the effects that the Project may have on the physical, biological, and social/cultural components of the environment. The EA forecasts any change that the Project may cause in the environment, as well as the effects of the environment on the Project.

The principal objective of the EA study is to predict the impacts that may be expected, should the Project proceed. The EA also identifies methods of enhancing positive environmental effects and reducing negative environmental effects.

1.1 Coleson Cove Refurbishment Project Background and Purpose

The Project will primarily involve the installation of extensive pollution control equipment, and the conversion to Orimulsion® fuel. The objectives of the Project are to reduce emissions, stabilize electricity rates and ensure a reliable source of energy for the province. The Project will realize major reductions in emission rates. These rates will be reduced by approximately 70% for nitrogen oxides (NOx); 77% for sulphur dioxide (SO_2); and 75% for particulate matter (PM).

The Government of Canada and the New England Governors and Eastern Canadian Premiers (NEG/ECP) are working co-operatively to achieve regional and national reductions in total SO_2 emissions. Although no timeframe has been finalized, emissions reduction implementation is expected by 2010 or earlier.

The New Brunswick Department of Environment and Local Government (NBDELG) has indicated that it is expecting a two-phase reduction of NB Power's existing annual SO_2 limit of 123,000 tonnes. Phase 1 will comprise a 30% reduction by 2005 (86,100 tonnes limit), and Phase 2 will comprise a 50% reduction by 2010 (61,500 tonnes limit).

The Certificate of Approval (COA) to Operate CCGS issued by NBDELG in January 2000, required NB Power to file an SO_2 emissions reduction plan outlining a proposed approach to achieving a target for this facility not to exceed 40,000 tonnes per year. This reduction plan was submitted as a report, "NB Power's Sulphur Dioxide Emissions Reduction Program – January 2001".

The Emissions Reduction Program sets out specific actions that satisfy potential SO_2 emissions constraints. To meet these potential regulatory requirements, NB Power's planned reduction program consists of the following main elements: retirement of the Grand Lake Generating Station; refurbishment of the Point Lepreau Generating Station; continued operation of the

Dalhousie and Belledune Generating Stations; utilization of low sulphur fuel in combustion turbine units; and, refurbishment of CCGS with emissions control technology.

In addition, the NEG/ECP have established targets for reductions in NOx emissions, such that NB Power's total emissions are expected to be reduced by 30% by 2007. As NB Power's largest single source of NOx emissions, reductions at the CCGS are an essential element in management of overall NOx emissions.

The Project is an essential element in both the Province of New Brunswick and NB Power plans to control future SO_2 and NOx emissions. Although other technical options for meeting the same emission reduction objectives have been considered (including the use of natural gas), the current analysis shows that the Project and conversion to Orimulsion® is the lowest cost option, with least impacts on the ratepayers of New Brunswick.

1.2 Regulatory Framework

1.2.1 Environmental Impact Assessment Regulation

In accordance with Regulation 87-83 of the *Clean Environment Act*, the Project was registered with NBDELG on July 25, 2001. On October 31, 2001, the Minister of NBDELG directed that a full Environmental Impact Assessment be undertaken. This EA report is submitted in response to that directive, and in accordance with Final Guidelines issued by NBDELG on January 15, 2002 and the Terms of Reference prepared by NB Power and dated February 26, 2002.

The Minister of NBDELG has appointed a Review Committee comprised of technical specialists from various government agencies whose jurisdictions may be affected by the undertaking. These agencies include:

- NB Department of the Environment and Local Government (NBDELG);
- NB Department of Natural Resources and Energy (NBDNRE);
- NB Department of Health and Wellness;
- NB Department of Agriculture, Fisheries and Aquaculture (NBDAFA);
- NB Department of Transportation (NBDOT);
- NB Culture and Sport Secretariat;
- City of Saint John;
- Saint John Port Authority;
- Environment Canada;
- Fisheries and Oceans Canada (DFO); and
- Transport Canada (Marine Safety).

The first major task of the Review Committee was to work with NBDELG in developing the Draft Guidelines for the EA study. The Draft Guidelines (issued November 15, 2001) outlined an approach NB Power should follow in conducting the EA. The Draft Guidelines also identified important issues that must be considered in assessing the effects of the Project.

Members of the public were invited to comment on the Draft Guidelines and to identify any issues of concern that did not appear in the document. Following public input, the Minister of NBDELG issued Final Guidelines (the Guidelines) for the EA study on January 15, 2002.

Terms of Reference were then prepared by NB Power to describe in detail the approach to be used by the Study Team during its preparation of the EA report. The Terms of Reference were submitted to the Review Committee on February 26, 2002.

This EA report is submitted for evaluation by the Review Committee to determine whether the study adequately addresses the Guidelines. If, on the advice of the Review Committee, the Minister of NBDELG is satisfied that the EA report is adequate, the next step is to engage the public in evaluating the assessment of effects.

A summary of the final report is then prepared on behalf of the Minister of NBDELG to assist the public to become familiar with and understand the information. The Review Committee will also prepare a General Review Statement summarizing the comments on the EA report.

The Final EA report and the General Review Statement are released for a period of 30 days for public review and comment. At that time, the schedule and location(s) of public meeting(s) will also be announced by the Minister of NBDELG.

Public meeting(s) will be convened, likely near the geographic location of the CCGS, and will provide all interested parties with an opportunity to make comments, raise concerns, or ask questions about any matter covered in the EA report. Subsequent to the public meeting(s), a period of fifteen days is provided for the public to submit further written comments to the Minister of NBDELG. At the end of that period, a summary of public consultation is prepared by NBDELG, presented to the Minister, and made available to the public. At any time after this date, the Lieutenant Governor in Council ("Cabinet") may make a decision to issue or deny an approval for the Project.

1.2.2 TERMPOL Review Process

It is NB Power's understanding that TERMPOL is a non mandatory review process, coordinated by Transport Canada, that is intended to help prevent incidents and spills and, in conjunction with requirements of the *Canada Shipping Act*, ensure that contingency plans are in place to respond to any spills that do occur.

Although the Project, and specifically the unloading of Orimulsion® at the Canaport monobuoy, does not involve any new terminal or facility, nor any changes to the monobuoy, information is being provided in this EA report that could, under other circumstances, be used to support a TERMPOL review.

Specifically, different sections of the EA report provide information on the following:

- project related marine shipping, ship design and operation (Section 4);
- existing infrastructure (Section 4);
- existing shipping activity in and around the Port (Section 5);
- risk and accident analysis along the transit route and at the terminal, and related mitigating measures (Section 7);
- pollution prevention program (Section 4); and
- contingency planning (Section 4 and 7).

1.3 Scope of the Coleson Cove Refurbishment Project

The existing CCGS consists of three boilers and turbine generator sets, each with a rating of 350 MW (gross) and each fired with Fuel Oil #6. In total, the CCGS has a capacity of 1050 MW. The CCGS was constructed between 1971 and 1975 as part of the then anticipated Lorneville Industrial Park. The first unit went into commercial operation in 1976.

The Project includes converting from Fuel Oil #6 to Orimulsion®, refurbishment to extend operations to approximately 2030, and installation of environmental control equipment.

Thus, the Project scope relates only to changes in the CCGS or its operation. Systems such as the (marine) cooling water (CW) system will not be changed, and, hence, do not lie within the scope of the Project.

The scope of the Project is described in the following sub-sections. A detailed Project description is presented in Section 4.0.

1.3.1 Construction

During the approximate 30-month construction period, the key features of the Project include the following:

- Employment of a construction labour force.
- Parking, transportation and associated features to support the Project labour force.
- Construction of new fuel storage facilities at the existing Canaport tank farm.
- Construction of a new fuel pipeline by others between Canaport tank farm and Bayside Drive.
- Modification of CCGS fuel storage facilities.
- Steam boiler modifications.
- Turbine efficiency improvement.
- New duct work for the flue gas from each unit.
- Replacement of powerhouse control systems with a Distributed Control System (DCS).
- Installation of Flue Gas Desulphurization (FGD) system, Wet Electrostatic Precipitator (WESP), and new stack.
- Installation of Material Handling Facilities for gypsum & limestone.
- Installation of ash packaging facility.
- Installation of new Wastewater Treatment Plant (WWTP) and wastewater recycling.
- Installation of new Solid Waste Storage and Disposal Area (SWSDA).
- Site Improvements.

1.3.2 Operation

During the 25-year operations phase, the actual operation of the CCGS will not be materially changed from current conditions. However, the various pollution abatement and environmental management measures will reduce the environmental effects of the CCGS operation on the natural environment. Thus, the aspects which require EA during the operation phase include the following:

- Possible changes in levels of airborne contaminants as a consequence of altered pattern of discharges of constituent materials, or an altered deposition pattern.
- Limestone/Gypsum transport.

- Fuel delivery systems.
- Freshwater consumption.
- Increases in Operations labour force.
- Operation of solid waste disposal facilities.

1.3.3 Decommissioning

Decommissioning of the entire CCGS, after its operation, would be expected in a manner consistent with the applicable sections of Environment Canada's "Environmental Codes of Practice for Steam Electric Power Generating Stations – Decommissioning Phase". NB Power would develop an overall plan for decommissioning the site, which would form the basis of a separate EA Registration at that time. This decommissioning plan would include establishing an "end use" objective for different parts of the site, a review of the site history, a strategy to identify and remediate any contaminated areas so as to achieve "end use" status, and details of the actual demolition activities to be undertaken.

This entire process would involve interaction with the various regulatory agencies, and would meet all regulatory requirements in place at that time.

1.3.4 Contingencies

During Operations, the CCGS will use Orimulsion® fuel, which has different characteristics from Fuel Oil #6. Hence, spill response planning has to take these differences into account. As well, the fate and effects of Orimulsion® in the natural environment could differ from Fuel Oil #6. Consequently, the scope of the EA includes unplanned releases such as a spill or discharge of Orimulsion® in the marine environment.

1.3.5 Overview of Final Guidelines

NBDELG, through the Review Committee, established the scope of the EA, and provided this information in the Guidelines, dated January 15, 2002. The following text (in italics) summarizes material from the Guidelines. Readers should refer to the Guidelines as the official statement of the scope of the EA.

Objective

The principal objective of the EA is to predict the impacts that can be expected, should the Project proceed. The EA is also expected to identify methods of optimizing positive impacts and minimizing negative impacts resulting from the Project.

Scope

To provide a focus for the EA, environmental components of principal concern, commonly referred to as Valued Environmental Components (VECs), must be identified early in the EA study through a scoping exercise. The method for conducting this exercise and the criteria for determining VECs must be clearly stated by the proponent.

The Guidelines identify specific issues to be studied:

- *Impacts on Air Quality.*
- *Impacts on Surface Water and Groundwater.*
- *Impacts on the Bay of Fundy.*
- *Transportation Issues.*
- *Socio-economic Impacts.*

- *Impacts on Terrestrial and Wetland Environments.*
- *Impacts on Surface Water Supply.*
- *Impacts of the Environment on the CCGS.*

The EA is required to address:

- *The capacity of renewable resources which are likely to be significantly affected by the Project to meet the needs of the present and those of the future.*
- *All aspects and phases of the Project.*
- *Any indirect, cumulative or synergistic effects.*
- *Potential impacts of the environment on the CCGS.*
- *Climate change considerations.*
- *Cumulative environmental effects individually for each VEC.*

Prediction of Effects

Predictive statements should be accompanied by a discussion of the limitations of the analysis, as well as references to supporting documentation.

Predictions must be made regarding the nature, magnitude, duration and distribution of the Project's environmental effects. These predictions must:

- *facilitate decision-making with respect to the Project;*
- *clearly specify any degree of uncertainty inherent in the projections;*
- *clearly identify impacts with respect to human health and tolerance levels of organisms in the environment; and*
- *be amenable to testing, where possible, through ongoing monitoring.*

With reference to predictions, the Proponent must define "significant" for the EA and clearly state the significance of project-induced changes on VECs.

Mitigation, Contingency and Compensation

The study must describe methods of mitigating (eliminating, preventing and minimizing) any negative environmental impacts. This should include a description of contingency measures that have been designed to address potential accidents and malfunctions which could result in spills or unplanned releases of contaminants to the environment.

Specific circumstances under which mitigative measures will be implemented must be clearly defined by the proponent. An outline for contingency plans must be provided:

- *for use in the event of an environmental emergency attributable to the Project, within the spatial boundaries of the study;*
- *for use in the event of significant impacts, attributable to the Project, which are detected through monitoring. This plan must be designed to be implemented should impacts be detected during construction and operation.*

The study must consider compensation mechanisms to be used in the event that any accidental or residual impacts occur. However, compensation should be recognized as a last resort.

A well-defined program of monitoring the effects of the Project must be outlined in the EA in order to:

- *establish baseline conditions of the current operation;*
- *test the predictions of the EA study; and*
- *evaluate the effectiveness of the measures used to prevent or minimize environmental impacts.*

Public consultation is required with persons and organizations potentially affected by the Project. The consultation should be well documented, and serve to ensure that the public is well informed, and that values and concerns are incorporated and adequately addressed in the EA.

1.4 Report Organization

The EA report is organized and presented in a sequence of stages. An Executive Summary provides an overview of the entire report. A Glossary provides an explanation of technical and industry specific terms. The main body of the EA report comprises eight sections, as follows:

Section 1 - The Introduction:

- Provides a context for the Project and for the EA.
- Outlines the scope of the Project and the Scope of the Assessment.
- Presents a "road map" of the EA.

Section 2 - Approach and Methodology:

- Describes the methods used to conduct the assessment and to make predictions.
- Describes the process of selecting the VECs.
- Describes the methods and provides definitions applicable to Environmental Effects prediction, including Cumulative Effects.

Section 3 – Public Consultation:

- Describes the objectives and methods applicable to the public and stakeholder consultation program conducted by NB Power.
- Provides a summary of the meetings and consultations, including a listing of the issues and concerns identified by participants.
- Describes how these issues and concerns have been incorporated into Project planning and design.

Section 4 –Project Description:

- Provides background information on the existing CCGS, and on the characteristics of the new fuel source - Orimulsion®
- Describes the Project by phases – design, construction, operation and decommissioning.
- Describes the nature and quantity of emissions and wastes to be produced.
- Describes Project labour requirements.

- Describes potential situations which could lead to spills or discharges, and the various preventative and response measures which apply.
- Describes alternatives to the Project, including the "No Project" alternative, alternative fuels, alternative fuel delivery options, and alternative pollution control technologies.
- Describes other projects and activities (which need to be taken into account in addressing cumulative effects).

Section 5 – Environmental Setting:

- Presents a description of biophysical and socio-economic environment.
- Describes the atmospheric environment (noise and air quality).
- Describes the terrestrial environment (physical, biological, species at risk and special habitats).
- Describes the marine and freshwater environment (freshwater, surface water, groundwater, fish/habitat and marine).
- Describes wetlands.
- Describes the socio-economic environment (local economy, population, labour force, industry and commerce, infrastructure, resource use, public health and safety, archaeological resources).

Section 6 – Valued Environmental Components:

- Presents the results of the Issues Scoping to identify Environmental Components of Concern (ECCs).
- Describes the Pathway Analysis to establish which ECCs are relevant to the Project and to the EA.
- Presents and defines the VECs and indicators which form the basis of the Effects Prediction.

Section 7 – Environmental Impact Assessment:

- Describes the approach to the prediction exercise.
- Provides an overview of studies conducted to support the EA.
- For each biophysical and socio-economic VEC, describes the scope of assessment, makes effects predictions, identifies mitigation measures, and predicts the residual effects (including cumulative effects) once these measures are taken into account.
- Addresses issues of sustainability, including rare and endangered species.
- Considers the effect of environment, including climate change, on the CCGS.
- Considers the overall cumulative effect of the Project.

Section 8 – Environmental Monitoring and Follow-Up Programs:

- Describes programs to monitor for adherence to regulations.
- Summarizes the results of past air quality monitoring at the CCGS site.
- Describes the monitoring studies which will serve to confirm effects predictions, and establish the effectiveness of mitigation measures.

Section 9 - References

Appendix A - Valued Environmental Component Table
Appendix B - Summary of Public Consultation Program
Appendix C - Contact List
Appendix D - Coleson Cove Design Drawings
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2.0 APPROACH AND METHODOLOGY

This section presents the methods used to conduct the EA, starting with the identification of issues and concerns and the selection of VECs. It provides an outline of the Project to be assessed (including all applicable boundaries), as well as the scope of the EA. The section also describes the methods used to predict effects, including cumulative effects, and the approach to the design of mitigation and monitoring programs. It provides descriptions of generic significance criteria and outlines the approach taken to addressing sustainability assurance.

2.1 Selection of Valued Environmental Components

The assessment focuses on the evaluation of potential interactions between the Project components and activities, and the ECCs that were identified through the issues-scoping process. Scoping was used to identify important issues related to the Project and focused the EA on high-priority issues (Kennedy and Ross, 1992). As suggested by Beanlands and Duinker (1983), this focusing exercise resulted in the identification of VECs. A VEC reflects a grouping of perceived public concerns related to social, cultural, economic, or aesthetic values. It also reflects expert opinion as to possible effects on the natural environment.

Thus, VEC selection involves the following steps:

- identify all issues and concerns from all stakeholders;
- organize and consolidate the issues and concerns into similar groupings as ECCs;
- examine each ECC for relevance (linkage) to the Project;
- consider the extent to which the Project design has addressed each ECC;
- select the VECs which encompass all remaining ECCs;
- define the scope of assessment and boundaries for each VEC; and
- select indicators for each VEC.

Several issues were identified by the Review Committee and documented in the Final Guidelines. In addition, the Project Team considered issues identified in previous EAs, relevant reports, experience with comparable projects, consultation with the public and regulatory community, landowners and other individuals knowledgeable about the Project.

VECs were identified through determining the pathways or linkages between the ECCs and the Project. Where pathways cannot be identified, the ECC was deemed not to be affected by the Project and, therefore, was no longer part of the analysis. Where Project design has addressed potential issues such that the effects are no longer a concern, these issues were also removed from further analysis.

For the purposes of the assessment, the interactions between Project outputs, or activities, and VECs are described as either positive or negative. The significance and likelihood of potential interactions are considered in accordance with the *Responsible Authority's Guide* (the Agency, 1994).

2.2 Boundaries

The effect of a specific project activity on a VEC may differ in both space and time from the effect of any other activity. Certain Project activities may have long-term consequences; others will be of short duration. Therefore, an important aspect of the EA process is the determination of study boundaries. Temporal and spatial study boundaries have been considered for the pre-construction/construction, operation, and decommissioning phases of the Project.

The spatial boundaries for construction include the CCGS site as well as any new pipeline and storage tank construction to be completed between the CCGS and the shipping terminal. The boundaries encompass those VECs which the assessment has determined are potentially affected. Spatial boundaries were identified for each VEC. Specific considerations were also given to the geographic ranges of particular identified VECs. Temporal boundaries for this phase are estimated to extend over a three-year period.

The operation phase includes spatial boundaries similar to the construction phase. For the operation phase, the temporal boundaries extend for approximately 25 years subsequent to completion of construction.

The spatial boundaries for decommissioning are expected to be similar to the construction phase boundaries. The temporal boundaries for decommissioning extend for about three years to allow the effectiveness of restoration activities to be monitored and to conduct required maintenance.

The prediction of environmental effects has, however, considered longer durations for those effects on VECs that could result in longer-term effects for all Project phases.

2.3 Assessment of Environmental Effects

2.3.1 General

Methods used in the identification and assessment of effects may be specific to each discipline. They can be grouped in the following categories:

- review of the literature, including primary literature as well as unpublished reports and data from government agencies and departments, universities and research institutions, and other similar, relevant projects;
- interviews with resource persons and knowledgeable individuals;
- use of models and extrapolation from datasets and trends;
- compilation of relevant statistical datasets;
- site visits and evaluations;
- public consultations through Open Houses, workshops, interviews, and formal and informal meetings; and
- formulation of effect hypotheses and linkages for each VEC determined to be potentially vulnerable to effects of Project activities.

Potential environmental effects are identified at the beginning of each Environmental Effects section. The significance of environmental effects was analyzed using the criteria: magnitude; geographic extent; timing, duration and frequency; reversibility; ecological and socio/cultural context; probability of occurrence; and the capacity of renewable resources to meet the needs of the present and those of the future. The definitions established for the ratings applied to "magnitude" and "reversibility" are outlined in Table 2.1. Positive environmental effects are also explained. Tables analyzing potential environmental effects using these criteria are included at the end of each VEC section.

TABLE 2.1 Definitions for Magnitude and Reversibility of Effects

Rating	Magnitude[1]	Reversibility
High	An environmental effect affecting a whole stock, population or definable group of people, or where a specific parameter is outside the range of natural variability determined from local knowledge over many seasons	Previous research/experience indicates the environmental effect is reversible
Medium	An environmental effect affecting a portion of a population, or one or two generations, or where there are rapid and unpredictable changes in a specific parameter so that it is temporarily outside the range of natural variability determined from local knowledge over many seasons	Previous research/experience indicates the environmental effect may be reversible
Low	An environmental effect affecting a specific group of individuals in a population in a localized area, one generation or less, or where there are distinguishable changes in a specific parameter; however, the parameter is within the range of natural variability determined from local knowledge over many seasons	Previous research/experience indicates that there is a small likelihood that the environmental effect is reversible
Nil	No environmental effect	Previous research/experience indicates the environmental effect is non-reversible
Unknown	An environmental effect affecting an unknown portion of a population or group or where the changes in a specific parameter are unknown	there is insufficient research/experience to indicate whether the environmental effect is reversible

Note 1: Definitions of magnitude for some VECs are specific and defined in the respective Effects Assessment section.

Predictions were based on a combination of objective (measurable) and subjective (deduced) experience based on professional judgement and evaluation.

The prediction tools used for this EA included the following mathematical models:

- Air Quality modelling.
- Multipathway Human Health Risk Assessment.
- Comparative Ecological Risk Assessment (CERA) (for the Marine Ecosystem of the Bay of Fundy).
- Groundwater/Leachate modelling.

- Economic Input Output modelling.
- Transportation modelling.
- Freshwater – modelling to identify pumping requirements .
- Noise modelling.

A summary of the model used in a particular analysis is included in the relevant sections of the EA.

2.3.2 Cumulative Effects Assessment

The environmental effects of the Project, in conjunction with other activities and other projects that have or will be carried out in the Project Area, were examined in accordance with the approach described by the *Cumulative Effects Assessment Practitioner's Guide* (the Agency 1999). For the purpose of identifying and assessing cumulative effects, the spatial dimensions of the bounded areas for each VEC remained the same. The temporal boundaries, however, were extended to include activities that are underway in the area, and other known projects planned outside of the time boundaries established for the Project. A review of other similar projects that have been operational for long durations (20-25 years) also provided insight into the potential cumulative effects of the Project.

The temporal scale of the cumulative effects assessment was based on the existing (pre-Project) condition as the baseline, since there is no practical means to establish historical (pre-European colonization) conditions. The existing condition is defined as including ongoing activities as well as planned activities/undertakings within the defined Project Study Area. These "other projects and activities" include: projects under construction; under regulatory review; recently approved; publicly committed (*e.g.*, by registration under EA legislation); or considered reasonably foreseeable. The objective was to produce a "most likely future scenario".

Where insufficient information on other projects or activities was available to assess their cumulative environmental effects with the Project, best professional judgement was used. The projects that may contribute to cumulative environmental effects that are being considered in this EA report are described in Section 4.8 (Other Projects). Cumulative environmental effects are addressed within each VEC section, and are considered where the Project is predicted to have measurable effect on the VEC. Only in cases where the prediction of residual effects identifies an impact that is greater than "negligible" (*i.e.*, minor, moderate or major), is there a need to consider cumulative impacts.

Cumulative effects assessment will be considered for each VEC, and conducted for that VEC, should the criteria apply.

Because of the overall importance of air quality, cumulative effects will be considered with respect to that VEC.

The cumulative effects assessment will not propose or establish thresholds. However, where these have been established (*e.g.*, air emissions, traffic volumes), the discussion of cumulative effects will incorporate these considerations, and make predictions based on potential for exceedances.

The determination of the significance of cumulative effects was based, wherever possible, on established and accepted mathematical models to provide quantitative estimates which can be compared against established thresholds. Significance will be considered with respect to discernible trends and a consideration of the magnitude of anticipated change. The level of uncertainty associated with predictive statements will be explicitly described. Where models are not available or applicable, professional judgement will be used to make predictions and assess significance.

There can be a broad range of possible mitigation measures, which can serve to reduce cumulative effects. These are not confined to actions by the Proponent, but can include government, industry and international initiatives. Therefore, the Proponent is not in a position to make commitments to implementation of such measures that are beyond its authority.

An overall consideration of cumulative effects is presented in Section 7.0 in order to consider the combined impact of all Project induced effects.

2.4 Determination of Significance

Residual effects are those environmental effects predicted to remain after the application of mitigation. Residual effects and their significance are presented in the "Residual Environmental Effects" sub-section of each VEC section. Following the conclusions reached in the "Environmental Effects Assessment" sub-section of each section, the significance of environmental effects, including cumulative effects, for a particular VEC is determined for each phase of the Project (construction, operation and decommissioning). In addition, residual environmental effects are also described for potential accidental events.

Wherever possible, the significance rating of each residual environmental effect integrates the cumulative environmental effects of all activities taking place during a particular phase of the Project. The rationale for this method is that a VEC, such as Air Quality, will be affected by the presence of the Project as a result of a number of factors experienced simultaneously (*e.g.*, CCGS emissions, vehicle exhaust). It is, therefore, the cumulative environmental effect of all Project activities occurring within a particular time period or phase that could result in an adverse environmental effect. In addition, a residual environmental effect significance rating was assigned to an accidental event scenario for a particular VEC.

A common scale of reference for determining significance is required to compare the relative importance of various environmental effects. An effect is only considered significant if it is both adverse and likely to occur. Significance has been based on scientific determinations, social values, public concerns, and economic judgements. The significance of Project-induced changes on VECs are considered for all issues and is as determined, based on the criteria set out in Table 2.2.

Within each VEC section of the effects assessment, specific definitions are provided to establish whether the predicted residual environmental effects are significant. Residual environmental effects that are moderate or major are considered to be significant. Residual environmental effects that are negligible or minor are considered to be not significant. This approach, and the associated terminology, has been used in recent major EAs (*e.g.*, The Voisey's Bay Mine/Mill Environmental Impact Assessment).

TABLE 2.2 Criteria to Determine Level of Significance when Determining Environmental Effects

Key Terms	Criteria
Adverse	• loss of rare or endangered species • reductions in species diversity • loss of critical/productive habitat • transformation of natural landscapes • toxic effects on human health • reductions in the capacity of renewable resources to meet the needs of present and future generations • loss of current use of lands and resources for traditional purposes by aboriginal persons • foreclosure of future resource use or production
Significant	• magnitude • geographic extent • duration and frequency • irreversibility • ecological context
Likely	• probability of occurrence • scientific uncertainty

Source:
CEAA, 1994: The Canadian Environmental Assessment Act: *Responsible Authority's Guide*, p.91.
CEAA, 1994: A Reference Guide for the *Canadian Environmental Assessment Act*, Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects, p.187-194.

For each VEC where significant residual adverse environmental effects are predicted, the likelihood of occurrence was assessed in terms of both probability of occurrence and scientific uncertainty. Definitions for likelihood ratings are shown in Table 2.3.

The sustainable use of resources (the capacity of an affected resource to meet present and future needs) was assessed for those renewable resources that are likely to be significantly affected. Concepts such as ecosystem integrity, productive capacity, carrying capacity, and assimilative capacity are considered. Definitions for the sustainable use of resources are also shown in Table 2.3.

TABLE 2.3 Definitions for Likelihood and Sustainable Use of Renewable Resources as Applied to Significant Residual Environmental Effects Ratings

Rating	Likelihood	Sustainable Use of Renewable Resources
High	An environmental effect is probable and there is no uncertainty based on previous scientific research/experience	Previous research/experience indicates that the environmental effect on the VEC would not reduce biodiversity or the capacity of resources to meet present and future needs
Moderate	An environmental effect may occur but there is some uncertainty based on previous scientific research/experience	Previous research/experience indicates that the environmental effect on the VEC may, to a certain extent, reduce biodiversity or the capacity of resources to meet present and future needs
Low	An environmental effect has a small probability of occurring and there is little uncertainty based on previous scientific research/experience	Previous research/experience indicates that the environmental effect on the VEC would reduce biodiversity or the capacity of resources to meet present and future needs
Nil	An environmental effect has no probability of occurring and there is no uncertainty based on previous scientific research/experience	Previous research/experience indicates that the environmental effect on the VEC would eliminate biodiversity or the capacity of resources to meet present and future needs
Unknown	There is insufficient research, experience, aboriginal knowledge to predict the likelihood of an environmental effect occurring	There is insufficient research/experience to indicate whether the environmental.effect on the VEC would reduce biodiversity or the capacity of resources to meet present and future needs

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3.0 PUBLIC CONSULTATION

This section summarizes the public consultation activities undertaken to date for the Project. Seeking public comments and the establishment of an early public consultation process has been and will continue to be a part of NB Power's project management strategy. NB Power's Public Consultation Program was undertaken to inform and receive feedback from stakeholders and the general public about NB Power's plans to refurbish the CCGS.

The program has consisted of the dissemination of information about the Project, the identification and documentation of issues, concerns and questions arising from stakeholders and the general public, and the steps necessary to mitigate or resolve issues and concerns. In addition, stakeholder input was sought to support the design of specific technical studies.

Key elements of the Public Consultation Program have included: notification, meetings, feedback vehicles, information management and follow-up activities.

3.1 Objectives

The objectives of the Public Consultation Program are to:

- provide information and seek input from members of the general public and other interested parties on NB Power's plans for refurbishment;
- identify, document and monitor issues and concerns arising from the process of public consultation; and
- identify planning, design and management measures that will mitigate or resolve public issues.

Since Spring 2001, NB Power has hosted a number of Public Information Sessions and met with numerous stakeholders to provide details and receive comments and input on the Project. This work will continue as the Project develops.

3.2 Public Information Sessions

NB Power held five Public Information Sessions between May 30, 2001 and March 31, 2002. The focus of these sessions was to present Project-related information on the need for refurbishment, economic benefits, fuel delivery options, the new pipeline, the EA process and timeline and to seek public input. A total of 184 people attended. The following sessions were held:

- May 30, 2001 – Saint John
- June 26, 2001 – Lorneville
- June 28, 2001 – Musquash
- October 22, 2001 – Saint John West
- December 13, 2001 – Fredericton

3.2.1 Notification and Schedule

Prior to each meeting, advertisements were placed in the local newspaper inviting the public to attend an information session on the Project. Radio ads were aired on two local radio stations and messages were placed on TVNB Message Express. In addition, invitations were faxed to key stakeholders and media advisories were issued. For the sessions on June 26, and June 28, 2001, signage was placed in the communities

3.2.2 Information and Documentation Presented

Attendees were greeted and invited to view the displays and converse with NB Power personnel. The sessions were hosted from 4:00 PM to 8:00 PM with the exception of the event held in Fredericton (from 2:00 PM to 6:00 PM). All sessions were open to the general public and media.

Information presented at the sessions included:

- information related to the CCGS;
- information related to the regulatory approval process;
- information related to environmental benefits and projected emission rates;
- poster and maps of the proposed pipeline route;
- a description of Orimulsion® and the delivery options;
- background documentation, including NB Power's Annual Report for the fiscal year 1999/2000 and NB Power's Environmental Performance Report; and
- Exit Questionnaires and contact information.

In addition to the information on display, the Vice-President of Generation gave a brief presentation on the Project to attendees. On May 30 and December 13, 2001, the Vice-President of Operations and Environmental Affairs of BITOR America gave a presentation on Orimulsion®.

Attendees were asked to complete an Exit Questionnaire when leaving the Information Session. A total of 88 Exit Questionnaires were completed during the Information Sessions held between May 2001 and March 2002. A copy of the Summary Results of Information Session Exit Questionnaires is tabulated and attached in Appendix B.

3.3 Other Stakeholder Meetings

Several meetings with key stakeholders were held to provide an overview of the Project and to explain the process in providing comments on the Draft Guidelines.

Key stakeholders were contacted by telephone, letter or fax requesting a meeting to discuss the Project. Stakeholder meetings were tailored to meet the needs of those in attendance. The stakeholder meetings held to date are shown in Table 3.1.

Topics discussed at these meetings covered a wide range of issues, including the Project description, review of the consultation process, description of the Terms of Reference, potential fuel delivery options, and the EA process and timelines.

TABLE 3.1 Stakeholder Meetings as of March 21, 2002.

Date	Stakeholders	# of Participants
11-Apr-01	Technical Review Committee and Key Stakeholders	27
26-Jul-01	Fundy North Fisherman's Association	9
15-Aug-01	New Brunswick Board of Commissioners of Public Utilities	18
24-Aug-01	Technical Review Committee	35
25-Oct-01	Industry/Government AQ Working Group	8
31-Oct-01	Spill Scenario Development Workshop	13
01-Nov-01	Conceptual Model Workshop	17
07-Nov-01	Canadian Manufacturers & Exporters - NB Branch	10
08-Nov-01	Enterprise Saint John	13
26-Nov-01	Grand Bay Westfield Town Council	14
28-Nov-01	Saint John Environment Committee	11
28-Nov-01	Enterprise Saint John	2
13-Dec-01	PC Party MLA Breakfast	22
13-Dec-01	Liberal Party MLA Dinner	7
20-Dec-01	Briefing Session – NDP	1
07-Jan-02	Saint John MLA's	12
24-Jan-02	APEGNB - Fredericton Branch	115
05-Feb-02	NBDELG and Dept of Health	4
05-Feb-02	Quispamsis Town Council	20
18-Feb-02	Department of Health	2
18-Feb-02	Saint John Citizens Coalition for Clean Air, Saint John Environment Committee	21
19-Feb-02	Conservation Council of New Brunswick	1
19-Feb-02	Department of Health	2
21-Feb-02	Atlantic Resource Industries Association	75
27-Feb-02	Mayor of Saint John	1
11-Mar-02	Saint John Common Council	30
20-Mar-02	St. Stephen Chamber of Commerce	45
21-Mar-02	New Brunswick Environment Industry Association	50

3.4 Issues, Questions and Concerns Noted

3.4.1 Public Information Sessions

During the Information Sessions, attendees were greeted and invited to view the displays and converse with NB Power personnel. NB Power kept a record of those who attended the various Information Sessions. Issues and concerns raised were addressed by members of the Project Team and tracked as they developed during the public consultation process. Most of the questions and issues were answered to the satisfaction of the attendees. During a de-briefing by Project Team members at the close of the session, it was noted that some questions could not be readily answered and required additional follow-up. If the issue related to a project matter, an NB Power representative made contact with the individual and followed up in an appropriate manner.

3.4.2 General Issues, Questions and Concerns

Over the course of public consultation, a number of common issues, questions and concerns were raised, from the look of the plume to the cost of the Project, details on the fuel, and job prospects. Table 3.2 lists the common issues, questions and concerns and notes the means of addressing each of them.

As some environmental issues remain outstanding, ongoing contact will be maintained with stakeholders to provide them with the requested information as the Project develops and details become available.

3.5 Feedback Vehicles

3.5.1 Exit Questionnaires

Feedback from attendees at the Information Sessions was collected through Exit Questionnaires and later entered into a computerized Issues Management System. A total of 88 Exit Questionnaires were completed and any attendee comments that required follow-up were flagged for action. (Appendix B)

3.5.2 Toll-Free Information Line

A toll-free information line was set up for public inquiries and the number was publicized in all print materials, notices, advertisements, letters and fact sheets. The telephone was staffed during regular business hours. That person logged all calls, responded to inquiries or requests for information and forwarded any inquiries that required more in-depth response to appropriate NB Power personnel. To date, 81 calls have been received, 49 of which were RSVP's, and 32 were calls requesting information.

3.5.3 Access to www.nbpower.com Web Site

NB Power has posted on its Web site the public information available on the Project including the regulatory applications and documents, fact sheets, contact information and the final Guidelines. It includes information on the Public Information Sessions and provides an e-mail link for contacting NB Power. A number of requests for information have come through this vehicle. Since November 2001, over 2000 visitors have reviewed information relating to the Project.

3.6 Information Management

NB Power kept a record of those who attended various meetings as well as a guest book for each Information Session. NB Power and/or its agents tracked issues as they developed during the public consultation process. All issues raised during the Public Information Program were tracked on the Issues Management Form. The details tracked included mode of contact, sector category, issues category and action to be taken.

TABLE 3.2 General Issues, Questions and Concerns

No.	Issues, Questions and Concerns	Means of addressing Issues, Questions and Concerns
1	Employment opportunities	Information was provided to the Project Manager and Contractors /who expressed an interest in the Project were encouraged to register as a supplier with NB Power.
2	Fuel supply	Detailed information was provided during the consultation process and addressed in the evidence presented to the Public Utilities Board.
3	Overall emissions	Details on the emissions were provided and interested persons were told that emissions will be addressed in the Air Quality Modelling study and filed with the EA. Information regarding the look of the existing plume was answered during the consultation process.
4	The timeline	This was addressed during the Public Utilities Board (PUB) hearings. The timing and issues with respect to events of the Project continue to be monitored.
5	Pier 10 fuel delivery option: • The tank • Noise • Pipeline • Emissions/smell • Land sloping issues	Canaport has been selected as the preferred fuel delivery option. Residents who expressed a concern about the tank and pipeline associated with the Pier 10 option have all been notified about the change.
6	What about Natural Gas	This question was addressed in the PUB hearings and restated for the benefit of those interested.
7	Spills/spill recovery	This will be addressed in CERA and discussed in the EA. Information on the procedures and equipment for spill recovery was provided.
8	Transport traffic	To be addressed in the EA. Information on the number of vehicles expected was provided.
9	Limestone supply	NB Power will contract for the supply of limestone. The source is not yet known.
10	Ammonia	The Selective Catalytic Reduction equipment is no longer required as other pollution prevention methodology has been selected for the Project.
11	Monobuoy at Coleson Cove	Canaport has been selected as the preferred fuel delivery option and details will be noted in the EA.
12	Freshwater supply	This will be addressed in the Freshwater Supply Study and noted in the EA.
13	Integrity of the existing pipeline	This will be addressed in the EA.
14	CO_2	Although a slight reduction in CO_2 emissions is expected from the Project, the refurbishment Project is not part of NB Power's CO_2 emissions management strategy.
15	Health effects of air emissions	This will be addressed in the Health Risk Assessment and noted in the EA.

3.7 Follow-up Activity

NB Power receives ongoing requests for general information and requests for potential job opportunities. These matters are addressed on a regular basis and follow-up is ongoing. This process is managed by Public Affairs and a schedule of issues, questions and concerns is reported on a weekly basis to NB Power.

3.8 Future Consultation Initiatives

A number of consultation initiatives will continue as the Project moves forward. These initiatives include:

- Working closely with the Technical Review Committee of the NBDELG.
- Scheduling of stakeholder workshops to address specific issues.
- Ongoing communications with the public, key stakeholders, regulators and others.
- Scheduling of Public Information Sessions to discuss the EA and ongoing Project information.

3.9 Conclusions

The Public Consultation Program undertaken by NB Power has identified a number of issues, concerns and questions associated with the Project and provided NB Power and its environmental consultants with important information. This information was helpful in selecting the preferred options, carrying out the EA process and assisting the Project Team in evaluating the environmental effects of this Project.

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4.0 PROJECT DESCRIPTION

This section presents, as background, a description of the existing CCGS, including the fuel delivery infrastructure. This is followed by a description of the Project. This description is consistent with the Scope of Project which is the subject of this EA. First, a description is presented of the proposed new fuel – Orimulsion®. This is followed by a description of the design, construction, operation and decommissioning of the Project. Also presented are the projected air emissions from the facility, the labour requirements associated with the Project, and safety and contingency planning to address the needs of the Project. Finally, a discussion is presented of the Alternatives associated with the Project. This includes the "No Project" alternative, as well as the alternatives within the Project.

4.1 Description of the Existing Station

The CCGS is located on the Lorneville Peninsula on the northern shoreline of the Bay of Fundy at Tiner Point, in Lorneville in the Parish of Musquash, St. John County in the Province of New Brunswick. The geographical location is in the Province of New Brunswick, St. John County and is identified as Property ID #00434522 as referenced by the New Brunswick Geographical Information Corporation.

The CCGS commenced operation in 1976. The current expected end of plant life is 2017. The site is located within an Industrial Park of about 3240 ha, which encompasses most of the peninsula south of Highway No. 1. This Industrial Park is totally enclosed by the western limit of the City of Saint John, and lies some 15 km southwest of the centre of the City. Most of the industrial park area is owned by Business New Brunswick, and is as yet undeveloped. The development of the industrial park has been the subject of a separate EA.

The total area of the site owned by NB Power is approximately 328 ha, of which about 30 ha have been developed. Primary access to the plant is via Highway No. 1, and then King William Road.

The site is irregular in shape, its southern boundary being defined by the shoreline. It measures approximately 2400 m from northeast to southwest by 1400 m from northwest to southeast. Virtually the entire site is steeply contoured from the shoreline inland, the only exceptions being those areas which were developed to accommodate the initial construction of the facility. Typical grades range from 5 to 20% with the land rising from mean sea level to a maximum elevation of 100 m at the centre of the property.

The station itself is located adjacent to the shoreline with the main boiler house on the seaward side and the turbine hall on the landward side. The plant switchyard and terminal facilities, as well as the tank farm, are located approximately 300 m from the station proper at an elevation of 40 m.

The CCGS generates a total of 1050 MW of electricity from the combustion of Fuel Oil #6. There are three identical units, comprising three boilers that burn the oil to generate steam. Each boiler powers a turbine-generator, each with a rated 350 MW electrical generating output capacity.

The Fuel Oil #6 at Coleson Cove is delivered through a 28 km pipeline from east Saint John to storage tanks on the plant site. Total Fuel Oil #6 storage on-site is approximately 1,200,000 barrels adequate for 30 days of full load operation.

The station is a conventional design; it has a single turbine hall enclosing three turbines and three separate boiler houses. Two dry electrostatic precipitators for each boiler, a total of six for the station, remove flyash from the flue gas leaving the boiler and are located on the seaward side of each boiler house. The flyash collected in the precipitators has a high carbon content and is re-injected and burned in the boiler. This improves efficiency through more complete combustion of the fuel and results in the ash being collected at the bottom of the boiler. This bottom ash is sold and trucked off-site for vanadium recovery. Vanadium is recycled for use in the steel industry.

The station has a triple-flue stack, located on the seaward side and centered on the station length behind Unit 2. Each of the three flues measures 4.9 m in exit diameter and 183 m in height. Gases exhaust at an approximate exit velocity of 30 m/s and approximate exit temperature of 170°C. One flue serves each unit and the three flues are contained within a single concrete windshield that measures 18 m in diameter at the base.

Monitoring at the station consists of gaseous continuous emissions monitoring in the stack and wastewater monitoring in the WWTP and the domestic sewage facility. Monitoring in these locations will continue after refurbishment. These facilities are discussed in detail in Section 4.3.

4.1.1 Existing Fuel Transport, Storage and Handling

In recent years, Fuel Oil #6 supply for the CCGS originates primarily from Venezuela and the US Gulf states. It is transported by oil tanker to the unloading facilities at Courtenay Bay operated by Irving Oil Limited (IOL). The fuel is off loaded for interim storage at the refinery in east Saint John. From there, it is delivered overland via a 300 mm buried pipe approximately 28 km in length. The pipeline fuel delivery rate is determined by the plant burn rate that can range from a minimum 7,000 to a maximum of 40,000 barrels per day.

In addition to Fuel Oil #6, a relatively small quantity of oil with a sulphur content of less than 1.25%, is stored on site. This fuel is utilized as startup fuel; however, it is available in sufficient quantities to serve as an alternate fuel for use during adverse atmospheric conditions (*i.e.*, when emissions of SO_2 must be limited).

4.1.2 Existing Plant Water Use

Water uses at the Coleson Cove plant include freshwater and seawater.

The station's total freshwater needs are supplied by a 600 mm pipe from the Spruce Lake Reservoir, which is located approximately 5 km north of the site. This line has a supply capacity of 33,200 m^3/day. The station's water needs are almost totally dependent upon its operational status, the only exceptions being the fire and domestic water supplies. Water consumption is in the order of 3,456 m^3/day. All freshwater treatment demands are satisfied by the station's water treatment plant, which contains the equipment necessary to accommodate chlorination, clarification, filtration, demineralization, and condensate polishing.

The station uses seawater in a once through circulating water system for the heat exchange medium in a variety of equipment coolers.

The CW intake structure is located on the shoreline at the west end of the plant and is protected from wave action by a natural rock barrier. Water from the bay passes through trash racks and a travelling screen arrangement and is directed to the individual unit heat exchangers, and then, is returned to discharge approximately 100 m offshore.

4.1.3 Existing Wastewater System

The CCGS operates a WWTP, and a domestic sewage facility which are licensed by NBDELG. Reports on the effluents from these facilites are submitted regularly to NBDELG. During the past six years of operation, between 98 and 100% of the monitoring results were within operating approval limits. The high level of compliance can be directly related to the station's; operational and maintenance practices, its quick response in taking corrective actions when monitoring results fall outside of approval limits, and its commitment to achieving the requirements of its approval to operate. The WWTP includes:

- in plant tankage, pump and ancillary equipment for the collection and transmission of wastewater to the treatment facilities;
- lagoons for flotation and recovery of free oil;
- two neutralizing lagoons complete with duplicate pumping station;
- chemical addition systems for control of effluent pH, flocculation, and soluble metal precipitation;
- one clarifier with duplicate effluent pumps for control of suspended solids;
- sludge dewatering system for control of suspended solids;
- sludge cake disposal site with return drainage to the wastewater treatment system;
- ferrous sulphate addition for corrosion control in the CW system; and
- discharge of treated wastewater to Coleson Cove via the cooling water system.

4.1.4 Existing Solid Waste Management System

The CCGS maintains a solid waste disposal facility for the disposal of WWTP sludge that consists of the following:

- waste disposal facility landfill, including Cells 1 and 2;
- surface water diversion ditches for waste disposal facility area runoff;
- ancillary equipment and pipelines; and
- leachate discharge piping to the WWTP.

4.1.5 Existing Gaseous Emissions

Gaseous emissions are released to the atmosphere from a triple flue 183 m stack with the top of the stack at 197 m above mean sea level.

The gaseous emissions are primarily composed of oxides of nitrogen, sulphur, and carbon; and particulate.

Sulphur dioxide emission management is achieved by the limit of the sulphur content in Fuel Oil #6. The Air Quality COA for the station issued under the terms of the *Clean Air Act* of New Brunswick specifies that sulphur content cannot exceed 3.0% by weight in any one shipment, and 2.75% by weight averaged over any calendar quarter. On an energy input basis, this results in emissions of SO_2 of approximately 2.63 lbs per million BTU's (lb/10^6 BTU).

A Supplementary Control System (SCS) Program has been adopted to control the impact of these SO_2 emissions during adverse meteorological conditions. This program uses emissions data in conjunction with meteorological and air quality data to predict ambient air quality. Air quality is maintained by the implementation of emission reduction controls if predicted ground-level concentrations meet or exceed the standard of 450 ug/m^3 for Saint John, Kings and Charlotte Counties. The standard for the rest of the province is 900 ug/m^3.

The existing CCGS was constructed with the capability to burn lower-sulphur fuel to reduce sulphur dioxide emissions if required. As well, emissions can be reduced substantially by a reduction of generation.

Particulate emissions are controlled by use of dry electrostatic precipitators.

Continuous Emission Monitors

Each boiler is equipped with continuous emission monitors (CEMs) for opacity and NOx, located in the flues downstream from the electrostatic precipitators, and used to measure emission levels to the atmosphere. SO_2 emissions are calculated by a software CEM. Oxygen (O_2) is measured for combustion control purposes within the boilers.

4.2 Orimulsion®

Orilmulsion® is a liquid fuel produced exclusively in Venezuela by Bitor.

Orimulsion® was specifically designed for use in electricity generation and the industrial sector. Since first developed, it is used in generating plants in Canada (Dalhousie, New Brunswick Generating Station), Germany, Japan, Denmark, and Italy. Orimulsion® has proven to be an economically competitive fuel alternative for electricity generating plants.

4.2.1 Properties

Orimulsion® is an emulsion of natural bitumen (approximately 70%), freshwater (approximately 30%), and a surfactant package (< 0.2%) and, therefore, has no single molecular formula.

Natural bitumen is a highly viscous (>10,000 cP at 30°C) and complex mixture of hydrocarbons which is difficult to pump in its natural state. Table 4.1 provides a summary of the physical and chemical characteristics of natural bitumen. To facilitate its transportation, natural bitumen is mixed with water in the production of a bitumen emulsion known as Orimulsion®. Orimulsion® -400, is the most current formulation of the fuel.

TABLE 4.1 Natural Bitumen Chemical and Physical Properties[a]

CHEMICAL PROPERTIES	
Parameter	Typical Value
Metals	
Nickel, ppm	110
Vanadium, ppm	450
Elemental Analysis (wt %)	
Carbon	85.30
Hydrogen	9.70
Sulphur	4.04
Hydrocarbon Groups (wt %)	
Saturates[b]	17
Aromatics[b]	47
Resins[b]	16
Asphaltenes[b]	20
PHYSICAL PROPERTIES	
Density, (15°C) g cm^{-3}	1.0180
Flash Point, °C	120
Gravity, API	7.5
Pour Point, °C	38
Viscosity, (30°) cP	>10,000

[a] Material Safety Data Sheet, 1998.
[b] Environment Canada, 1998

Orimulsion® -400, the current fuel formulation, contains a surfactant package of alcohol ethoxylates (AE) and monoethanolamine (MEA). AEs are the most widely used class of nonionic surfactants worldwide. The most common use for these compounds is in household laundry detergents. In terms of human health and safety, AEs are not considered hazardous and they are only slightly toxic to test animals via oral, dermal, or inhalation routes. AEs have no reproductive, teratogenic, or mutagenic properties.

The database that has been developed on the toxicity of AEs to aquatic organisms is large. Acute toxicity values (LC_{50}) range from 0.5 to 12.0 mg/L, depending on the compound and the species tested. Due to the rapid biodegradation of the parent AE compound, the initial toxicity observed steadily decreases over time (Ankley and Burkhard, 1992). It is generally accepted that the biodegradation products of AEs are not acutely toxic (Kravetz *et al.*, 1991). The primary degradation of alcohol ethoxylates is rapid, usually within three days. The ultimate degradation products of these compounds are carbon dioxide and water.

Monoethanolamine (MEA), diethanolamine (DEA), and triethanolamine (TEA) are often termed the ethanolamines. Industrially, these compounds are used as intermediates in soap and surfactant production, corrosion inhibitors, and gas conditioners (acid removal). MEA is used in the production of Orimulsion®. Knaak *et al.*, (1997) and Davis and Carpenter (1997) compiled information on both the toxicity and environmental fate of ethanolamines. Studies indicate that MEA has a low potential for toxicity to aquatic species.

Physical Properties

Physical properties of Orimulsion® -400 were evaluated and described by Environment Canada (1998) and Battelle (1998); Table 4.2 summarizes these data, including typical values provided by PDVSA-BITOR (Marrufo *et al.*, 1998).

TABLE 4.2 Summary of Physical Properties of Orimulsion® -400

Physical Test Parameter	Battelle	Environment Canada	PDVSA-BITOR
Water Content (wt %)	NM	30	27.5-30.2
Mean Particle Size Diameter (μm)	18.5 ± 0.3	19	14-20
Density (g/mL) at 15.0°C	1.0106	1.0095	1.013
Pour Point (°C)	3.0	0	3
Flash Point (°C)	>94	>95	>90
Surface Tension at 15°C (mN/m)	ND	35.4	ND

NM - Not Measurable
NP - Not detectable

For Orimulsion®, the typical transportation and storage temperature of products is approximately 32°C. The pour point of bitumen is 38°C, making it essentially a solid at room temperature; however the pour point of fresh Orimulsion® is low at approximately 3°C. The flash point is high (>90°C); in reality, the water content of Orimulsion® (30%) would prevent spontaneous ignition of the fuel. Furthermore, the bitumen component undergoes very little evaporation, thus precluding the build-up of ignitable fumes. Almost all of the evaporation from Orimulsion® would occur from the water component of the fuel. Orimulsion® is classified as non-flammable under the National Fire Protection Agency (NFPA).

Chemical Properties

The chemical composition of the natural bitumen in the Orimulsion® formulations reflects its highly degraded nature. The relatively high concentrations of nickel and vanadium in Orimulsion® are a common feature of the Cerro Negro bitumen and Venezuelan crude oils.

The chemical characteristics of Orimulsion® -400 have been evaluated by Environment Canada (1998) and Battelle Memorial Institute (1998). Results are summarized in Table 4.3. Environment Canada's (1998) chemical analysis included: sulphur, saturates, aromatics, resins, and asphaltenes (SARA) analysis; volatile organic compounds (VOCs); and alkyl polycyclic aromatic hydrocarbons (PAH). Orimulsion® -400 is predominantly comprised of aromatic hydrocarbons and resins that collectively accounted for 63% to 69% of the fuel. These values are consistent with those typically encountered in highly weathered Venezuelan crude oils.

It is notable that the concentrations of PAHs and benzene, toluene, ethylbenzene, and xylene (referred to as BTEX – see Table 4.4) are relatively low in Orimulsion® products, as compared to other low American Petroleum Industry (API) fuels. PAH and BTEX compounds are also present in crude oils at much higher concentrations, and are of interest because of their potential acute and chronic toxicity when released into the aquatic environment (see next Section). There were no detectable n-alkanes observed by Battelle (1998) in the Orimulsion® -400 analyzed. This was expected, given the highly weathered properties of the natural bitumen.

TABLE 4.3 Major Chemical Components of Orimulsion® -400

Parameter	Orimulsion® -400[a]
Sulphur (wt%)	2.85[b]
Hydrocarbon Groups (wt%)	
Saturates*	14
Aromatics*	47
Resins*	22
Asphaltenes*	17
VOCs (ppm)	
Benzene	0
Toluene	4
Ethylbenzene	19
Xylenes	13
Total BTEX	36
PAHs (µg/g bitumen)	
C_0-C_4 Naphthalenes	774
C_0-C_4 Phenanthrenes/ Anthracenes	1,140
C_0-C_4 Dibenzothiophenes	671
C_0-C_4 Fluorenes	310
C_0-C_4 Chrysenes	145
Total C_0-C_4 PAH	3,040
Metals (ppm)	
Nickel	75
Vanadium	320[b]
Zinc	0.9

Sources:
a. Environment Canada, 1998, except sulphur and metals.
b. Marrufo *et al.*, 1998 (typical values).

TABLE 4.4 PAH Concentration in Orimulsion® - 400

Compound	Orimulsion® Composition (mg/kg)
Naphthalene	10
C1-naphthalenes	28
C2-naphthalenes	84
C3-naphthalenes	124
C4-naphthalenes	228
Biphenyl	3
Acenaphthylene	ND
Acenaphthene	7
Dibenzofuran	3
Fluorene	7
C1-fluorenes	34
C2-fluorenes	115
C3-fluorenes	192
Phenanthrene	40
Anthracene	ND
C1-phenanthrenes/anthracenes	81
C2-phenanthrenes/anthracenes	243
C3-phenanthrenes/anthracenes	304
C4-phenanthrenes/anthracenes	186
Dibenzothiophene	17
C1-dibenzothiophenes	77
C2-dibenzothiophenes	253
C3-dibenzothiophenes	545
C4-dibenzothiophenes	436
Fluoranthene	2
Pyrene	7
C1-fluoranthrenes/pyrenes	39
C2-fluoranthenes/pyrenes	65
C3-fluoranthenes/pyrenes	85
Benz(a)anthracene	3
Chrysene	9
C1-chrysenes	25
C2-chrysenes	50
C3-chrysenes	54
C4-chrysenes	30
Benzo(b)fluoranthene	2
Benzo(k)fluoranthene	1
Benzo(e)pyrene	2
Benzo(a)pyrene	3
Perylene	4
Indeno(1,2,3-c,d)pyrene	ND
Dibenz(a,h)anthracene	ND
Benzo(g,h,i)perylene	1

[a] Orimulsion® -400 data is the average of three individual samples (Battelle, 1998 and USCG, 1999).
ND - not detected (<1 mg/kg).

Toxicological Properties

The toxicity to aquatic organisms of Orimulsion® has been studied using North American and European species. These data are consistent across laboratories and document the range of species sensitivity to this fuel (Johnson, *et al.*, 2000). In most cases, Orimulsion® is low in toxicity compared with other hydrocarbon products. Table 4.5 presents a summary of aquatic toxicity data for Orimulsion®-400.

TABLE 4.5 Acute Toxicity to Aquatic Organisms of Oil-in-Water Dispersions of Orimulsion® -400

Test Species	Test Type (Reference)	LC_{50}/EC_{50}
		Orimulsion® -400 (ppm, nominal)
BACTERIA		
Microtox (*Vibrio fischeri*)	saltwater, 15-minute test (1, 2)	2,579 - 2,800[a]
ALGAE		
(Selenastrum capricornutum)	freshwater, 72-hour chronic (1)	>1,000 (100% stock)
(Skeletonema costatum)	saltwater, 72-hour chronic (4)	500
INVERTEBRATES		
Crustacean (*Acartia tonsa*)	saltwater, 48-hour acute (4)	650
	22-day chronic (4)	10 (egg production)
Sea Urchin (*Lytechinus pictus*)	saltwater, 20-minute fertilization (2)	5,730
(*Paracentrotus lividus*)	fertilization (1)	296
Mysids (*Mysidopsis bahia*)	saltwater, 96-hour acute (3)	24.6-42.7[a]
Rotifer (*Brachionus plicatilis*)	freshwater, 24-hour acute (1)	653
Branchiopod (*Artemia salina*)	saltwater, 24-hour acute (1)	>1,000
Amphipod (*Corophium orientale*)	saltwater, 10- and 20-day chronic (1)	601 (10-d) 293 (20-d)
Crustacean (*Thamnocephalus platyurus*)	freshwater, 24-hour acute (1)	>1,000 (100% stock)
Water flea (*Daphnia magna*)	freshwater, 48-hour acute (1)	464
FISH		
Turbot (*Scophthalmus maximus*)	saltwater, 96-hour acute (4)	<2,000
Inland Silverside (*Menidia beryllina*)	saltwater, 96-hour acute (3)	114-200[a]
Rainbow Trout (*Onchorhynchus mykiss*)	freshwater, 96-hour acute (2)	301
Threespine Stickleback (*Gasterosteus acculeatus*)	saltwater, 96-hour acute (2)	3,200

Reference Key:
a. Two values available for this test.
(1) Golder Associates, Geoanalysis 1999; (2) Environment Canada, 1998; (3) Johnson, *et al.*, 2000;
(4) Bjomstead *et al.*, 1998, WAF used.

Further information on the toxicological characteristics are included in the CERA (Golder, 2002), including information on local species.

4.2.2 Behaviour in the Environment

The density of Orimulsion® and bitumen is intermediate between freshwater and seawater and is a function of the water salinity and temperature. The bitumen in Orimulsion® has an API gravity that ranges in value from 7.8 to 9.3 (specific gravity 1.01 to 1.02). Because of this characteristic, Orimulsion® is classified as a Group V oil (*i.e.*, petroleum products with specific gravity equal to or greater than 1.0) under regulations developed as a result of the *Oil Pollution Act* of 1990 (USCG, 1997).

Orimulsion® -400 spilled in seawater readily disperses throughout the water column. This behaviour is affected primarily by the concentration of the fuel, the salinity of the receiving water, and the prevailing environmental conditions. At higher salinities, the bitumen particles have a tendency to rise, but when combined with a dynamic environment, currents and waves, the bitumen particles are continuously mixed in the seawater column preventing the formation of a bitumen surface slick. Bitumen particles in the seawater column are dispersed primarily by subsurface currents and tides.

Laboratory studies have been conducted to simulate the behavior of Orimulsion® -400 spills in saltwater environments (Environment Canada, 1998; Battelle, 1998; CEDRE, 1998; AEA, 1998; Masciangioli, 1998). The behaviour of Orimulsion® -400 was investigated using a dynamic flume tank at Battelle (1998) to simulate open water dispersion conditions. In these experiments, the changes in bulk properties and chemical composition of Orimulsion® -400, and the changes in concentration of important compounds and surfactants in the water column, were tracked over time in order to document the behaviour and weathering of the product.

During the Battelle (1998) experiments, when Orimulsion® -400 was introduced into saltwater, the product was rapidly and completely dispersed into the water column as a plume of bitumen particles.

The surfactant package in Orimulsion® -400 is designed to be stable in the freshwater contained within the fuel. In the marine aquatic environment, the surfactants will quickly degrade into products generally accepted as not acutely toxic to aquatic organisms. The ultimate degradation products of the surfactant package are carbon dioxide and water.

Biodegradation of the heavy/weathered hydrocarbon components, such as bitumen, usually occurs very slowly, becoming quantitatively significant on the scale of months to years. Natural biodegradation and photodegradation of petroleum-derived hydrocarbons may not play a substantial role following a spill on a total mass basis, but it is likely to be an important fate process over longer periods of time. Sedimentation, either through direct settling of the weathered bitumen particles or indirect adhesion of the bitumen particles to particulates suspended in the water column, which may eventually settle out, may be an eventual fate pathway of some of the bitumen particles which remain in the water column after a spill (Harwell *et al.*, 1995).

In summary, if Orimulsion® -400 is accidentally spilled into the aquatic environment, the water phase will quickly dilute into the surrounding water and the bitumen particles will disperse throughout the water column, based on the salinity/temperature and dynamic conditions of the receiving water. Most important, a surface oil slick will not form following a spill of Orimulsion® - 400, mitigating/minimizing the ecological impacts associated with oil slicks.

4.3 The Project

NB Power's objectives in the Project are:

- to reduce emissions
- to maintain a reliable source of energy
- to provide stable and competitive rates.

The refurbishment Project will enable NB Power to improve environmental performance while continuing to generate electricity from the station through to 2030.

The fuel switch to Orimulsion® is a major element of the refurbishment Project. The Orimulsion® fuel will be supplied through a long-term, 20 year contract with Bitumenes Orinoco, S.A. (Bitor), a subsidiary of Petroleos de Venezuela, S.A. The fuel will be transported by tanker and unloaded at Canaport monobuoy facility near Saint John Harbor. From Canaport, the fuel is to be pumped via a pipeline to Coleson Cove.

The scope of the Project includes the addition of new equipment and the modification and upgrade of existing equipment, including:

- New fuel storage tanks, pipeline and pumps at Canaport.
- Contined use of the existing Coleson Cove fuel delivery pipeline system.
- Refurbishing the existing fuel storage facilities at CCGS.
- Boiler system modifications.
- Addition of emission control equipment:
    - Reburn combustion system to control NOx emissions
    - FGD to control SO_2 emissions
    - WESP to control sulphur trioxide (SO_3) emissions
- Refurbishment of the existing dry electrostatic precipitators.
- New DCS.
- New Stack.
- Material Handling Facilities for gypsum and limestone.
- New ash packaging facility.
- New WWTP.
- New Solid Waste Storage and Disposal Area (SWSDA)
- Related site and efficiency improvements.

Environment Canada's "Environmental Codes of Practice for Steam Electric Power Generation – Design Phase" (Environment Canada, 1985) will be applied in the new system design.

The following sections provide a detailed description of the planned facilities and modifications to the existing plant. Appendix D provides a series of design drawings with reference to the Project.

4.3.1 Fuel Delivery and Storage

Canaport

The selected option for fuel receiving is the existing monobuoy at Canaport owned by IOL and located off Red Head, east of Saint John. Canaport is part of Saint John Harbour.

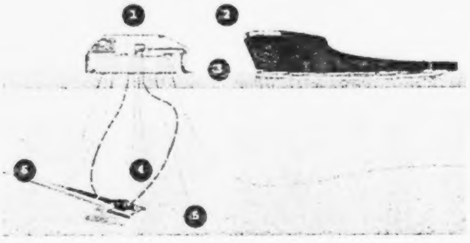
Canaport was designed to be the primary off-loading source for Canada's largest oil refinery, in Saint John, New Brunswick. Since installation the facility has successfully handled a wide variety of vessels. The ongoing operation of the facility is a key component of the operation of the Irving refinery. The marine traffic serving Canaport over the years has co-existed with ongoing commercial shipping, fishing and recreational vessels. The success of vessel management in the Bay of Fundy reflects the consistent application of Canadian shipping regulations and strong commitment on the part of vessel owners and Irving administration to the continued safe operation of the Canaport facility.

The Canaport Facility has been in operation for approximately 27 years. Approximately 5 years ago, an exclusion zone was established around the Monobuoy by the Harbour Master as a degree of safety and to help avoid pollution as per the National Oil Spill Avoidance Strategies.

The exclusion zone is defined by a circle with a radius of 1/2 nautical mile (925 m) centered on the charted position of the Monobuoy. All vessels, including fishing vessels and associated fishing gear must remain outside of this zone while a ship is moored to the Monobuoy. Vessel traffic to the Monobuoy is estimated between 20 and 60 Very Large Crude Carriers (VLCCs) annually.

NB Power is confident that, given its historic excellent operational record and the importance of this facility as the primary crude oil unloading source for the refinery, Canaport will continue to be operated safely and efficiently in compliance with industry practices and applicable regulations.

A typical monobuoy is a deepwater floating facility designed and best suited for unloading large tankers, as shown in the sketch below. The monobuoy (1) is firmly anchored using anchor chains (5) to the seafloor. Tankers (2) moor to the buoy. Floating hoses (3) are lifted and connected to the tanker. Orimulsion® is pumped by the tanker through these floating hoses to an underbuoy hose (4) that carries the Orimulsion® to the subsea pipeline (6) to on-shore fuel handling facilities.



Safe, practical and proven, monobuoys have been used around the world for decades. The Canaport monobuoy in Saint John has been in operation since the early 1970's.

Ship unloading facilities at Canaport will unload the Orimulsion® tanker capacity of 150,000 tons in approximately 36 hours. The existing monobuoy and piping system will be used. The tankship will be equipped with pumps capable of pumping the Orimulsion® through the existing monobuoy piping system at Canaport now used to unload crude oil. An operating procedure will be used to displace the crude oil and maintain separation between the two fuels. No modifications to the monobuoy are planned as part of this Project. Following Project approval and prior to first delivery, detailed operating procedures will be developed and available.

At this time, it is planned that Orimulsion® will be delivered via the undersea pipeline to a new pumping station and piping system on shore that will pump the fuel to new storage tanks that will be constructed at an extension of the existing Canaport tank farm. The storage tanks will be built at the existing tank farm, in compliance with the New Brunswick *Petroleum Products Storage and Handling Regulation*. The storage tank(s) capacity will be adequate to receive all of the unloading tanker fuel capacity, and allow operational flexibility.

A new water separation system will be installed at the tank farm to ensure discharges meet regulatory requirements. A similar facility has been in successful operation at the Dalhousie Generating Station and allows compliance with regulatory requirements.

Vessel Design

At this time, it is expected that Suezmax-sized double hull tankers with a capacity of approximately 150,000 tons Deadweight (DWT) will deliver Orimulsion® to the Canaport monobuoy. The current fleet utilising Canaport ranges in size from about 120,000 DWT to 350,000 DWT with a mean size of about 240,000 DWT.[1]

Table 4-6 summarizes the differences between the current NB Power heavy fuel oil fleet, which will be displaced from Courtenay Bay by this Project, and the design vessel intended to deliver Orimulsion® to Canaport.

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[1] Analysis of Saint John Port Authority vessel traffic data.

TABLE 4.6 Vessel Characteristics required by Bitor at Loading Port

	Existing Heavy Fuel Oil Fleet	Orimulsion® Fleet
Size (deadweight tons)	36,000	150,000
Hull Construction	Mostly Single Hull	Double Hull
Age (mean years)	16.5	7.5[1]
Officer Language Requirements	No requirement	English speaking and crew's mother tongue
No. of Tanks	12	12
Tank Size (m^3)	3,000	12,500
Classification Society	No limitation	IACS Member
Pollution Liability Insurance[2]	$500 million	$1 billion

Note: 1. The mean age of Orimulsion® tankers is based on an estimation of the normal distribution of tankers between new construction and 15 years, the maximum age of tankers used by Bitor for Orimulsion® deliveries.

2. Currently, insurance amount is a function of vessel size and is available through the normal vessel liability insurance provided by the Protection and Indemnification Clubs.

Fuel Transfer to CCGS

A new pipeline will be constructed from Canaport to join with the existing Lorneville pipeline which currently operates to deliver Fuel Oil #6 across the city to the fuel storage tanks located at Coleson Cove (Figure 4.1).

The maximum pipeline throughput capacity will be approximately 52,000 barrels per day at a pressure of up to 500 psi. This increases the existing throughput capacity by approximately 30%, required because of the 30% water in Orimulsion®. The capacity increase will be accommodated by locating pumping stations along the pipeline route, 1) at the Canaport storage facility; 2) at East Saint John; and 3) at the Lorneville Industrial Park.

The new on shore Orimulsion® facilities at Canaport will be designed, constructed and operated in compliance with Provincial Regulations. The pipeline will be designed in accordance with the applicable Canadian Standards Association (CSA) codes, and will include flow and pressure monitoring and alarm systems for spill management, all in compliance with the applicable Oil and Gas Pipeline Systems code CSA Z662-99. The pipeline will include facilities to allow for regular inspections, in accordance with industry standards. This predictive maintenance of the pipeline provides for identification and repair of irregularities before a failure or a potential spill occurs.

The integrity of the existing fuel oil pipeline, including infrastructure used for fuel delivery, was reviewed by Mark R. O'Neill & Associates, who are experts in pipeline operations, maintenance, corrosion, rehabilitation, construction and engineering. The review comprised a detailed evaluation of the "Lorneville" pipeline that runs from the IOL refinery to the CCGS.

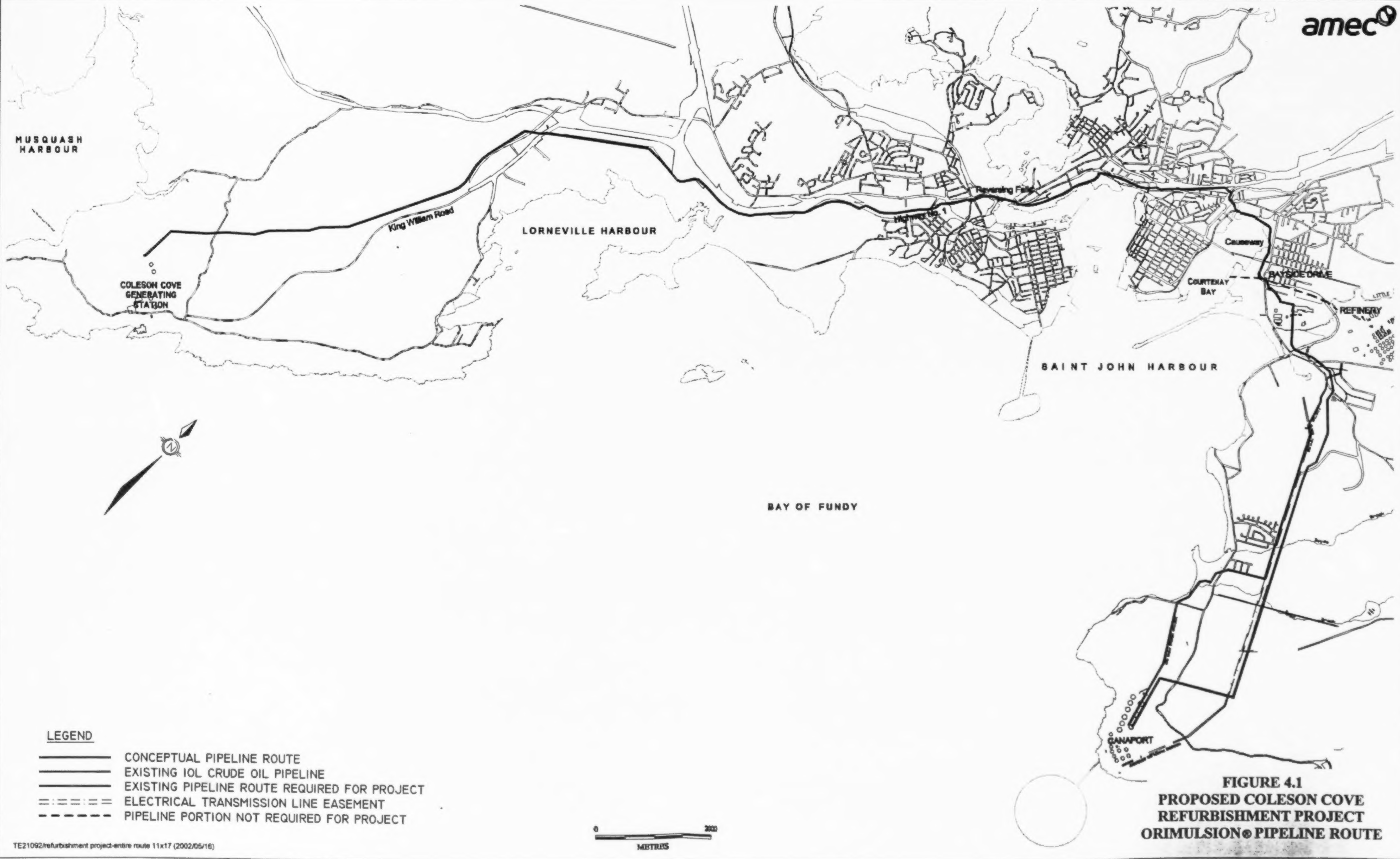

amec
MUSQUASH HARBOUR
King William Road
LORNEVILLE HARBOUR
COLESON COVE GENERATING STATION
Reversing Falls
Highway No. 1
Causeway
COURTENAY BAY
BAYSIDE DRIVE
LITTLE
REFINERY
SAINT JOHN HARBOUR
BAY OF FUNDY
CANAPORT
N
LEGEND
CONCEPTUAL PIPELINE ROUTE
EXISTING IOL CRUDE OIL PIPELINE
EXISTING PIPELINE ROUTE REQUIRED FOR PROJECT
ELECTRICAL TRANSMISSION LINE EASEMENT
PIPELINE PORTION NOT REQUIRED FOR PROJECT
0
2000
METRES
TE21092/refurbishment project-entire route 11x17 (2002/05/16)

FIGURE 4.1
PROPOSED COLESON COVE
REFURBISHMENT PROJECT
ORIMULSION® PIPELINE ROUTE

The evaluation included a review of records (maintenance procedures, inspection reports, repair/remediation reports) and two pipeline surveys - In Line Inspection (ILI) and Close Interval Cathodic Survey (CIS) completed in November and December, 2001 and the results compared with an earlier (1996) survey. The ILI survey detects anomalies or "areas of concern" where the pipe wall may be thinner than the specified dimension. CIS survey examines the working integrity of the cathodic protection system.

Mitigation measures can include:

- Improvements to the cathodic protection system (added rectifiers, increased current flow through rectifiers, and additional sacrificial electrodes and/or ground beds); or
- Repair (pipeline section replacement or installation of an outer sleeve over the suspect section).

The expert review noted that the Lorneville pipeline was over-designed during the original installation in 1974. It was installed with a design strength of 1631 psi (11200 kPa), and initially assigned a maximum allowable operating pressure (MAOP) of 816 psi (5600 kPa). To meet the requirements of the customer, the line was operated at a lower pressure through its life.

The expert's review noted that IOL has had, and continues to have, an action plan in place to maintain a safe, reliable pipeline. For example, it was noted that the company's remediation program for the Lorneville Pipeline is in accordance with, and often exceeds the pipeline industry standards for in-service facilities.

Following an ILI survey in 1996, IOL completed a pipeline rehabilitation program which included an eight hour hydrostatic test (at 150% of the MAOP). This test verified the pipeline integrity, safety and reliability.

The review considered the presence of anomalies in or near the Saint's Rest Marsh area. No excavation or other intrusion will be required at this time along the section of pipeline near the Marsh.

An expert consultant has recommended an Integrity Action Plan following the 2001 surveys to assure the service life of the line for a minimum of thirty years. NB Power has confirmed that IOL will incorporate the recommendations.

CCGS Fuel Storage and Delivery

The existing fuel storage facility includes four Fuel Oil #6 tanks and one light oil (No. 2) tank. Each tank is 64 m diameter by 14.6 m high and has an existing storage capacity of 300,000 barrels. All five tanks will be converted for the storage of Orimulsion®. No new storage tank will be constructed at Coleson Cove for the Project. Inspection, assessment, and repair of the existing tanks will be conducted as part of the refurbishment Project.

The existing fuel delivery line from the tank farm to the powerhouse will be replaced by a new 500 mm diameter line. The new pipe will be installed along the existing dyked fuel delivery line routing, using the same pipe rack. All fuel piping from the tank farm to the powerhouse will be heat traced and insulated.

The five existing tanks are located within earth dykes. The dykes are constructed of compacted earth and lined with impervious materials. Each dyke is a maximum of 3 m high and can contain 110% of the tank capacity.

Runoff from the tank farm is controlled through valved discharge to a settling pond. Under current operation, these discharge valves remain closed. Runoff from the tank farm containment areas is not released before inspection by operating staff. The five storage tanks will provide storage for 1,400,000 barrels of fuel, equalling approximately 27 days supply of fuel at full station load (2200 bbls/hr).

Light oil will be available for start-up ignition fuel and will be stored in the existing ignition fuel storage tanks near the Unit 1 boiler house.

All fuel storage tanks in place at CCGS are licensed by the NBDELG, in accordance with the *Petroleum Product Storage and Handling Regulation* under the *Clean Environment Act*.

4.3.2 Emission Reduction Equipment

The exterior of the existing powerhouse, boiler houses, and dry electrostatic precipitators will remain unchanged, however the installation of the sulphur emission control equipment will include the addition of equipment and buildings on the eastern end of the existing powerhouse to accommodate the FGD system and the WESP. Material handling facilities will also be constructed in this area.

The dimensions of the FGD building are approximately 45 m by 90 m in plan and 60 m high. The FGD building will be connected to the powerhouse at Unit No. 3 boilerhouse. Flue gas ductwork from the powerhouse will enter the FGD on the western side of the building. The duct work for the scrubbed gas will exit through the roof of the building, and lead to the new stack.

The Project will achieve significant reduction in emission rates of NOx (70%), SO_2 (77%) and PM (75%). These emission reductions will be accomplished with the installation of the appropriate control technology for each application.

Boiler System Modifications

The most significant and major change will be in the burner system to achieve the target NOx emission reduction. NB Power has worked with consultants and control equipment suppliers to select the best combination of control technology to achieve each of the target emission rate reductions. In terms of providing adequate emission control, the approach for NOx emission control is pollution prevention (pre-combustion control) designed to prevent the formation of NOx emissions.

Reburn Combustion System to Reduce NOx

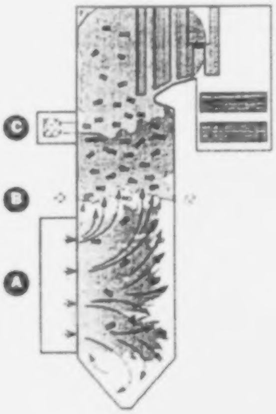
Emissions of NOx are produced in the boiler, primarily at the burners, a result of a high temperature (1400 °C) reaction of the molecular nitrogen and the oxygen in the combustion air, and the nitrogen in the fuel.

The combustion system in the existing boiler will be replaced with a system designed to reduce the production of NOx. The system will prevent the formation of the NOx in the boiler and, therefore, it is a recognized best available control strategy for the control of NOx emissions.

A reburn combustion system controls the combustion temperature and involves three basic components (see sketch below):

A. The first combustion zone, the main burners, consist of low-NOx burners where 80% to 85% of the Orimulsion® fuel is burned.
B. The second zone, the reburn burners, is where the remaining 20% to 25% of the Orimulsion® fuel is introduced to form a fuel rich burning zone. In this zone, NOx is converted to elemental nitrogen, thus the control of NOx emissions.
C. The third and final zone, the overfire air injection, is where air alone is injected to allow combustion of any of the remaining unburned fuel.

Generation of NOx is thus minimized at source, in the combustion zone. The expected emission rate is on average 0.21 lb/MMBTU in the flue gas leaving the boiler.

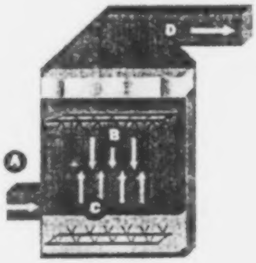


FGD System

Orimulsion® fuel contains 2.85% sulphur. During the combustion process, the sulphur in the fuel combines with the O_2 in the combustion air to form sulphur compounds, reported as SO_2.

NB Power has selected a FGD system, a worldwide proven technology to manage the sulphur emissions contained in the flue gas leaving the boiler.

The FGD system is shown in the following sketch and described through the following process:



Flue gas containing sulphur dioxide SO_2 enters the bottom of the tower.

A. As the gas rises, a sprayed slurry of water and limestone (H_2O + $CaCO_3$) chemically reacts with the SO_2 in the gas to remove the SO_2.
B. The calcium sulphite produced by the scrubbing action of the slurry collects on the bottom of the absorber tower.
C. The desulphurized flue gas leaves the FGD.

The FGD system for CCGS will be a two module tower system. Each absorber tower will be sized for 50% of the station full load flue gas flow. This approach was chosen to provide greatest operational and maintenance flexibility and enables the station to remain on the FGD system when either of the FGD modules are taken out of service (Figure 4.2).

The final step in the process involves removing the gypsum slurry from the absorber and dewatering it inside the FGD plant. The resultant gypsum cake is suitable for wall board production. Gypsum will be transported via enclosed conveyor to the Material Handling facility.

The FGD plant will include a limestone handling and preparation system. Five days of bulk dry storage will be provided in silos within the building. Bulk limestone (3/4" crushed - 20 mm) will be received in the material handling area and transported to the FGD plant by an enclosed conveyor.

amec

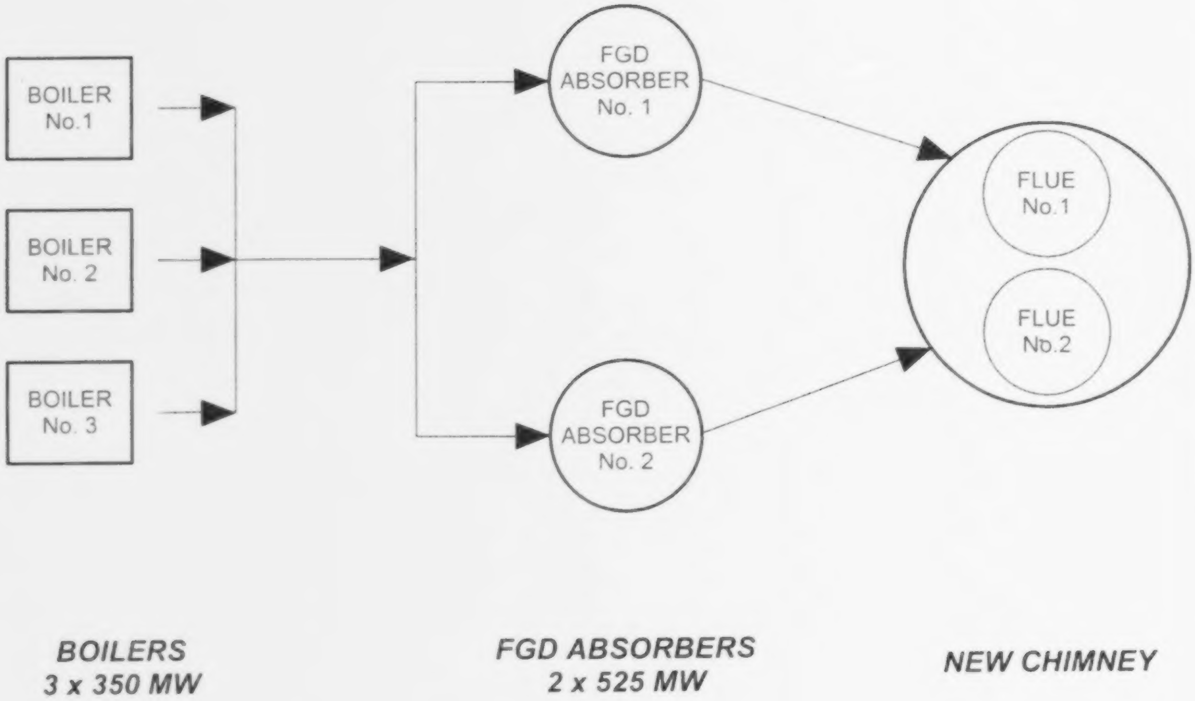

BOILER No.1
BOILER No. 2
BOILER No. 3
FGD ABSORBER No. 1
FGD ABSORBER No. 2
FLUE No.1
FLUE No.2
BOILERS 3 x 350 MW
FGD ABSORBERS 2 x 525 MW
NEW CHIMNEY

FIGURE 4.2
BOILERS AND FGD
FLUE GAS SCHEMATIC

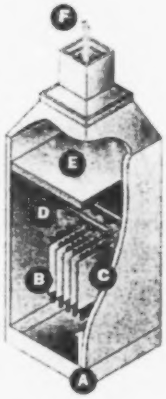
TE21092/boiler schematic (2002/05/16)

WESP

The WESP is used to capture SO_3, a major component of the fine particulate emissions. The primary concern with SO_3 emissions is the contribution to the visible plume leaving the stack. This has been an on-going operational concern with the CCGS.

The WESP is described through the following process:

A. Wet saturated desulphurized flue gas leaving the FGD enters the WESP.
B. High voltage electric field is produced to impose an electrical charge to the SO_3 particles.
C. The particles are removed from the gas stream by oppositely charged collection plates. The process affects only the particles being removed and does not constrict the gas stream.
D. The collector plates are washed with water and the collected SO_3 particles are washed back and collected in the FGD system.
E. The flue gas passes through mist eliminators to remove any entrained moisture droplets before exiting out the stack.
F. The clean flue gas now exits out the stack.



The WESP, in conjunction with the existing electrostatic precipitators, will lead to a reduction in the total particulate emission rate of approximately 75%.

Two WESPs will be installed for the Project, each located at the outlet of the FGD absorber tower.

Flue Gas Desulfurization (FGD) Technology

There are currently over 7 units totaling 4000 MW that use wet limestone FGD systems (Table 4.7) with forced oxidation when firing Orimulsion®. These units would be similar in design and operation with the FGD system used by NB Power at the Dalhousie Generating Station. The operation represents approximately 34 years of unit experience where SO_2 reduction is 90% or greater.

The Project Equipment Supplier also has experience on successful installation of over 26 Wet FGD Systems, including Orimulsion® facilities since 1990.

TABLE 4.7 Generating Stations Currently Using Wet Limestone FGD Systems

Utility	Country	Number of Units
NB Power Dalhousie G. S.	Canada	1
SK Power Asnaes, Unit 5	Denmark	1
ENEL Brindsi Sud, Units 1 & 2	Italy	2
ENEL Fiume Santo, Unit 3 & 4	Italy	2
Kansai Electric Osaka, Unit 4	Japan	1

NOx Control Technology Application

NOx control techniques proposed for use on the Project have been demonstrated on Orimulsion®. The NOx combustion control equipment options include low excess air, low NOx burners, flue gas recirculation (FGR) reburn and over-fire air.

NOx control technology design selection is dependent on the specific boiler and target emission control limit. The combustion NOx control is identified as "pollution prevention" control as they operate to limit formation of NOx in the combustion process, in the boiler.

Table 4.8 lists utilities which currently operate or have operated on Orimulsion® using some or all of the combination of NOx control technologies. Again, their specific combination of selected control is dependent on the boiler design parameters and their regulated emission limit targets. ENEL currently has over 1300 MW of oil fired operation using various NOx control technologies including reburn to meet a NOx emission control of 0.20 lb/MMBtu. Orimulsion® reburn has been demonstrated at Illinois Power.

TABLE 4.8 Generating Stations Using NOx Control Technologies

Utility	Country	Number of Units
SK Power Asnaes, Unit 5	Denmark	1 x 640 MW
ENEL Brindsi Sud, Units 1 & 2	Italy	2 x 660 MW
ENEL Fiume Santo, Unit 3 & 4	Italy	2 x 320 MW
Kansai Electric, Osaka, Unit 4	Japan	1 x 156 MW
Illinois Power Co., Unit 1[1]	U.S.A.	1 x 74 MW

[1] Illinois Power Co, a demonstration project on Orimulsion® reburn.

The Project Equipment Supplier also has experience on recent successful installation of over 15 NOx Control Systems.

Wet Electrostatic Precipitator Technology Application

The visual plume at Coleson Cove is a public concern. The majority of SO_3 formed in the boiler process goes unreacted through the FGD system and is in fact condensed into an aerosol in the FGD system. These aerosols have a particle size within the wavelength of light, they reflect light, and contribute to the visual plume.

The WESP planned for the Project will reduce fine particulate including SO_3, and the visual plume.

WESP experience on Orimulsion® is the retrofit at the Dalhousie Generating Station. The WESP is more commonly used in the refining and mining industry with recent application in the power industry Table 4.9 lists the Project Equipment Supplier Wet Electrostatic Precipitator Experience List.

TABLE 4.9 Project Equipment Supplier Wet Electrostatic Precipitator Experience List

	Utility	Process
1	AES Deepwater Cogeneration Houston, Texas	Power Generation 200 MW
2	Northern States Power Minnesota	Power Generation 2 x 750 MW
3	ARCO Refinery Washington State	Refinery
4	CODELCO - EL Teniente, Chile	Metal refinery
5	Grupo Mexico Southern Peru Copper, Peru	Metal refinery
6	Noranda CEZinc Valleyfield, Quebec	Metal refinery

4.3.3 Efficiency Improvement

In the design of new facilities and as part of the refurbishment Project, efforts will be undertaken to improve operating equipment efficiencies. The currently identified major equipment efficiency optimization will occur as follows:

- Turbine efficiency improvements that will result in a 3% improvement in the overall plant heat rate, a reduction of fuel consumption and corresponding reduction in all gaseous emissions.
- Higher Efficiency motors benefits will be most obvious with the selection of variable frequency drives (VFD) for large horsepower electrical motors
- A new DCS will be selected as part of the refurbishment to replace existing power plant controls including the new emission control systems, the reburn combustion control, FGD and WESP. These systems will be designed to allow the operator to optimize the plant operating performance and efficiency.

4.3.4 Flue Gas Path Modifications

The existing precipitators will be strengthened. In addition, each unit will undergo inspection and assessment to determine the extent of the refurbishment required in order to extend their operating life.

New Unit Ductwork

New flue gas ductwork will be installed to route the flue gas from each existing unit precipitator to the new FGD system. Unitized ductwork will be elevated on structures along the seaward side of the powerhouse in order to clear the existing ductwork and equipment. The unit breeching ducts, 7 m in diameter, will terminate at the FGD inlet plenum where the three gas streams will be combined and routed into two individual absorber towers.

Existing Ductwork & Stack

To meet the requirements of the NFPA, the existing stack will remain available for service. A shut-off damper will be added, and will remain normally closed so as to isolate the stack from normal operation. The stack and ductwork equipment will be refurbished as part of this Project.

The NFPA code requires that a boiler, on loss of electrical power to operate the boiler fans, must be capable of being vented unobstructed to the atmosphere. The new arrangement with the flue gas from the three boilers directed to a common FGD will not adequately satisfy this requirement. Maintaining the existing stack will satisfy the NFPA code requirement in the event described above. The normally closed damper will open to the existing stack and allow the exhaust gases remaining in the boiler to vent to the atmosphere, in the event of loss of power to the fans.

4.3.5 Chimney

A new 183 m tall concrete chimney will be constructed to receive flue gas from the FGD system. The Chimney will be located adjacent to the FGD building and contain 2 flue gas liners (one from each FGD tower) within a single windscreen. Emissions will be monitored with CEM for opacity, particulate, SO_2 and NOx. Provision will be made for gas stream sampling at mid height level of the stack in accordance with the Environmental Protection Agency (EPA) testing methods. Wet condensate precipitating from the flue gas leaving the stack is captured in the base of the flues and will be routed back to the FGD for re-use in the absorber towers.

4.3.6 Material Handling

Material handling facilities for limestone and gypsum will be located within a common yard east of the FGD facilities. Weigh scales will be installed in the yard to measure the inflow and outflow of materials. Entrance to this area will be restricted by fences and gates.

The yard area will be lined and surface drainage routed to a settling sump. Runoff in the sump will be monitored prior to discharge. Discharge from the sump will be in accordance with the applicable regulated standards. A buried connection to the WWTP will be installed as part of the Project. In the event discharge does not meet discharge criteria, it will be diverted to the WWTP, for further treatment.

A separate flyash packaging and storage facility will be constructed adjacent to Unit 1 boiler house and the water treatment plant.

Limestone

The supply of limestone will be contracted for delivery to the plant where it will be received and stored on-site inside the Material Handling building. In addition, there will be a seven day "emergency storage pile" located in the materials handling yard. Given the large diameter of the raw limestone, and based on experience at the Belledune Generating Station, dusting is not expected to be an issue. The emergency stockpile will be used in the event of an interruption in limestone delivery. The limestone will be transferred from the materials handling facility to the FGD silos by an enclosed conveyor.

If the supply of limestone is from offshore, there may be a requirement for additional storage.

Annual limestone requirements, with all units burning Orimulsion® are shown below, in Table 4.10.

TABLE 4.10 Limestone Requirements

	Tons/year (approximate)	Trucks/week (approximate)
Limestone	Up to 280,000	155
Assumptions: Truck Capacity = 40 tons		

Truck traffic associated with limestone delivery will average 2-3 trips per hour (8-10 hr/day).

Gypsum Loadout

The gypsum cake will be transported from FGD area to the material handling facility by an enclosed conveyor. The FGD is designed and will be operated such that the final product will be suitable for gypsum wallboard. Gypsum produced at both Dalhousie and Belledune Generating Stations is currently sold to wallboard manufacturers.

Provision for truck washing will be made near the material handling building. All drainage from the area will be directed to the yard sump.

Any unmarketable gypsum (off-spec product) will be landfilled at the solid waste management area. In practice, experience at Dalhousie and Belledune has shown FGD systems to be very reliable at producing marketable gypsum, with significantly more than 90% of the gypsum marketed. Provision has been made to landfill 10% of the total yearly production.

Annual gypsum production rates with all units burning Orimulsion® is shown below, in Table 4.11.

TABLE 4.11 Annual Gypsum Production

	Tons/year (approx)	Trucks/week (approx)
Marketable Gypsum	Up to 500,000	270
Assumptions: Truck capacity = 40 tons		

Truck traffic associated with gypsum transport will average 4-5 trips per hour (8-10 hrs per day).

Expressions of interest have been requested and, in the future, NB Power will enter into an agreement for the removal and use of gypsum. In Belledune and Dalhousie, all the gypsum is provided to a wall board manufacturer, who ships the material in bulk by ship from the Port of Belledune.

Given the relatively large quantities, it is considered likely that the purchaser will move the material in bulk through the Port of Saint John by a combination of truck and/or ship and/or rail. The purchaser will be required to implement dust control measures, consistent with the nature and form of the material to ensure compliance with the provincial *Clean Air Act* and meet the requirements of the Port, as is the case for materials related to the Dalhousie and Belledune Generating Stations. Some gypsum could be used in New Brunswick.

Whatever the final disposal option, any gypsum that is moved by truck from site will be transported through the industrial park to the divided four lane Highway No. 1 and all trucks will be tarped. Any gypsum that cannot be marketed can be stored at the solid waste management facility. This site will be easily accessible, and the gypsum would be retrievable. This is the same approach that has been used at the Dalhousie and Belledune Generating Stations.

Ash Management

Like all fossil fuels, Orimulsion® has a small component that is not combustible which is commonly called ash, or the ash content of the fuel. The ash content of fossil fuels includes such non-combustible components such as zinc, vanadium and nickel.

During combustion, the non-combustible components turn into what is called either bottom ash or flyash. In the case of Orimulsion®, about 10% of the ash converts to bottom ash whereas 90% is converted to flyash. The bottom ash is more dense and falls to the bottom of the furnace where it can be either mechanically or manually removed on a routine basis. The flyash is not as dense as the bottom ash and tends to get entrained in the combustion gases and is carried out of the furnace with the other gases products of combustion. The flyash is removed from the gas stream as it passes through the electrostatic precipitators (ESP).

Both bottom ash and fly ash will be recovered in a dry state and packaged for shipment to an end user (vanadium/heavy metal recycler). Prior to packaging fly ash, a densification process is used to increase the bulk density of the fly ash. Figure 4.3 illustrates the fly ash management option.

The total amount of ash will depend on the fuel ash content and amount of magnesium oxide present in the fuel. Magnesium, as magnesium hydroxide, can be added to the fuel to inhibit high temperature corrosion in the boilers. The maximum ash production, based on 0.12% w/w maximum ash in fuel and 180 ppm magnesium added to fuel, is about 550 kg/hr at full load.

About 10% of the ash will be recovered as bottom ash within the dry bottom ash pit of the boiler. The majority of the fly ash will be recovered in the existing dry fly ash ESP and transported by a dry dense phase pneumatic conveying system to a common storage silo. Fly ash not recovered in dry form will be retained in the gas stream and recovered in the scrubber and WESP.

The ash densification and packaging process will i) increase the bulk density by water addition in a mixer, ii) control pH and heat generated by exothermic reactions, iii) control fugitive dust emissions and iv) allow bulk packaging in sealed bulk bags and/or drums. Specific features include:

- Ash will be stored in a silo to allow for day shift operation of densification and packaging system. Air used to transport the dry ash to the silo will be filtered using a conventional silo-baghouse filtering system, prior to vent air to the atmosphere.
- Service water will be added to the ash with a controlled metering system such that sufficient water is added to cause agglomeration or balling of the ash-water mixture. This process may be a batch or continuous process.
- A wet scrubber will be used to scrub the moisture and solids entrained in the vent gas from the mixer and packaging units. The slurry allowed to build-up in the vent wet scrubber will be added to the fly ash in the mixer.

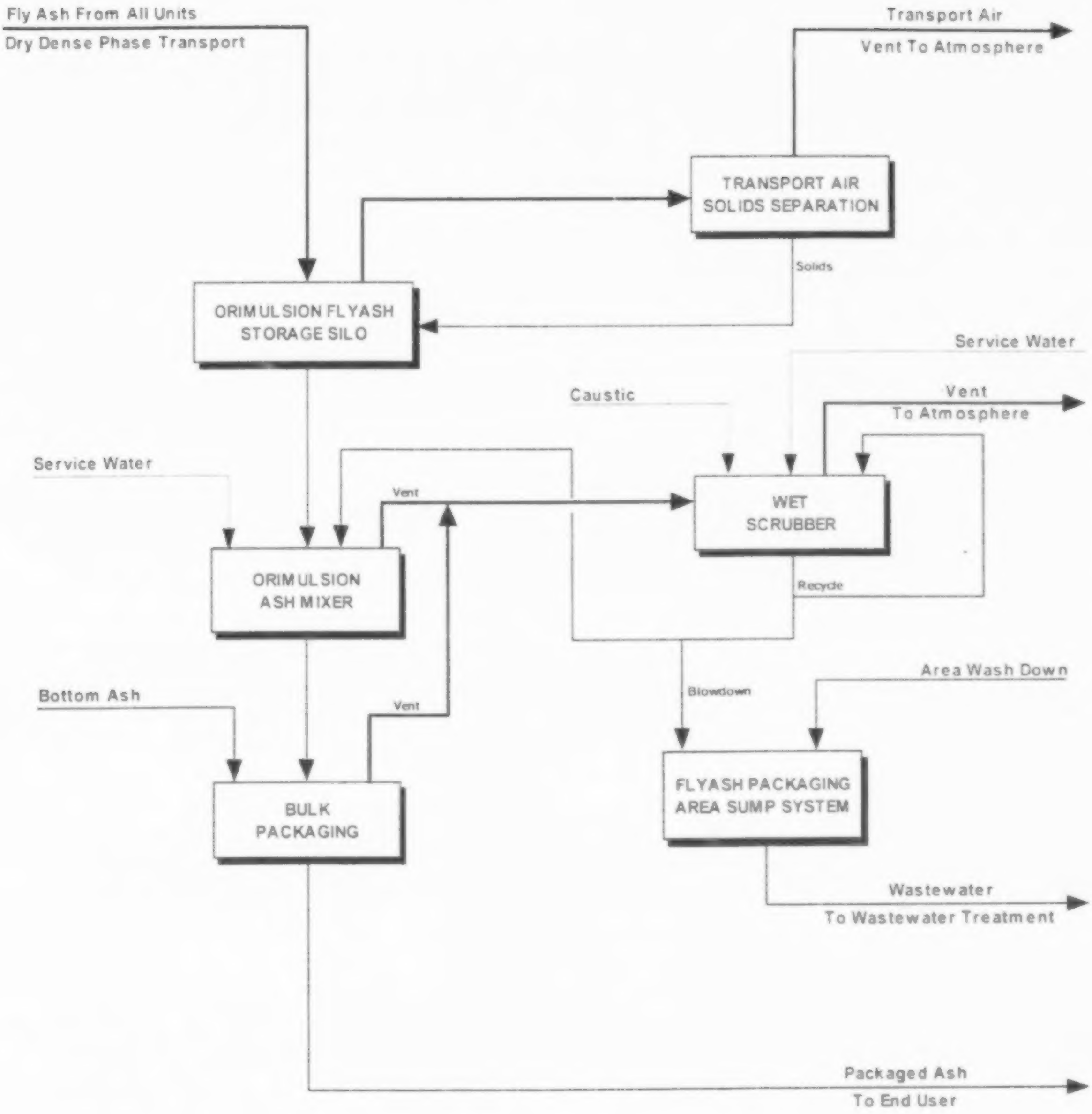

Fly Ash From All Units
Dry Dense Phase Transport
Transport Air
Vent To Atmosphere
TRANSPORT AIR SOLIDS SEPARATION
Solids
ORIMULSION FLYASH STORAGE SILO
Service Water
Caustic
Vent
To Atmosphere
Service Water
Vent
WET SCRUBBER
ORIMULSION ASH MIXER
Recycle
Blowdown
Area Wash Down
Bottom Ash
Vent
BULK PACKAGING
FLYASH PACKAGING AREA SUMP SYSTEM
Wastewater
To Wastewater Treatment
Packaged Ash
To End User

FIGURE 4.3
FLY ASH MANAGEMENT OPTION

TE21092/fly ash (2002/06/10)

- Agglomerated solids will be packaged in 500 to 1000 kg lots suitable for shipment to the end user.
- Blowdown from the scrubber and area washdown will be collected in a sump and routed to wastewater treatment.

All wastewater generated by densification and packaging operations will be routed to wastewater treatment.

4.3.7 Solid Waste Storage and Disposal Area

The CCGS currently operates a SWSDA for the sludge from the WWTP. Current facilities will not be able to accommodate increased volumes of sludge or potential "off spec" gypsum.

In comparison with the present operation, the refurbished station will produce more sludge from the wastewater related to the operation of the FGD system. A new waste management area will be designed and planned for the life of the plant (25-years). All cells to be constructed will meet provincial landfill guidelines. A suitable area was identified in 1986, and this area is still considered suitable as a potential area for the new landfill. The following information is taken from studies conducted at that time (WGA, 1986).

The proposed disposal site lies in a natural drainage basin flowing from an area to the northeast of the oil tank farm to Frenchman's Creek/Burchills Brook and Musquash Harbour. The total drainage area is approximately 250 ha. The basin is in a shallow bowl with surrounding elevations of 100 m to the south and 90 m to the northeast. The floor of the valley gently dips toward the sea at a gradient of approximately 0.013. Groundwater flow beneath the proposed disposal site is generally from east to west. Permeabilities in the bedrock are secondary due to the numerous small joints, fractures and faults. Average values are expected to range from 1×10^{-5} cm/s to 1×10^{-7} cm/s.

No public water supplies exist in the site or down gradient from the site.

The landfill will be developed in a cellular fashion with each cell constructed for approximately five years of capacity. One cell will be built initially, and others as required. The disposal cells will be lined and have a leachate collection system leading to a settling pond. After each cell is completed, it will be capped to reduce leachate production.

All the leachate and runoff from the SWSDA will be collected and routed to the WWTP. There, it will be treated as required, and either reused in the FGD, or monitored and discharged in accordance with the COA."

Although the main use of the SWSDA is for disposal of sludge, experience at Dalhousie and Belledune Generating Stations indicates that every year there is likely to be a small amount of off-spec gypsum that cannot be sold and that, during commissioning, there will also be a period when gypsum cannot be sold.

Table 4.12 presents the projected material anticipated for disposal and storage.

TABLE 4.12 Projected Storage and Disposal Requirements

Product	Tons/Year	Tons/5 Years
WWTP Sludge	12,500	62,500
10% Off-spec Gypsum	52,400	262,000
Provisional storage	100,000	100,000

4.3.8 Freshwater Supply System

Currently the CCGS uses about 3456 m^3/day supplied by the City of Saint John from the Spruce Lake water supply system. The water is delivered through a dedicated pipeline that runs to the industrial park, and then to the site.

The FGD system will increase freshwater requirements since water is used to make the limestone slurry. The FGD system will require 4320 m^3 /day of water, which will come from two sources – the Station's existing plant freshwater supply (Spruce Lake, the City of Saint John) and from water that is recycled from the WWTP. Approximately 3456 m^3 /day is predicted to be recycled from the WWTP, so the increase in demand on the Spruce Lake water supply is predicted to be about 4320 m^3 /day. Figure 4.4 illustrates the fresh and sea water systems.

Freshwater is converted into high-pressure steam in the boilers, which in turn drives the turbines. Once freshwater has gone through this cycle, it is cooled and condensed back to freshwater and then reheated (recycled) to drive the turbines again.

Freshwater is also used for operational maintenance requirements (e.g., cleaning purposes) and for potable water supply. In addition, freshwater is requred for the fire protection system.

The Canadian Centre for Climate Modelling and Analysis (CCCMA) has used General Circulation Models, or Global Climate Models (GCMs) to evaluate and to project future climate changes based on predicted increases in CO_2 in the atmosphere. The CCCMA results have been used to drive some Canadian smaller models. The findings of these models indicate that by 2050:

- The June-July-August precipitation minus evaporation differences would be about 30% over global land areas (*i.e.*, a significant decline in average soil moisture);
- Temperature increases over Atlantic Canada would range from about 1 to 4 degrees Celsius (relative to 1961-1990 average);
- A winter precipitation increase of 0 to 20% is projected for Atlantic Canada, with only small increases projected for precipitation in summer; and
- Winter and summer soil precipitation and soil moisture in the southern and western Maritimes are projected to remain within 20% of the 1975 to 1995 average, even by the end of the 21st century (*Bruce et al., 2000*).

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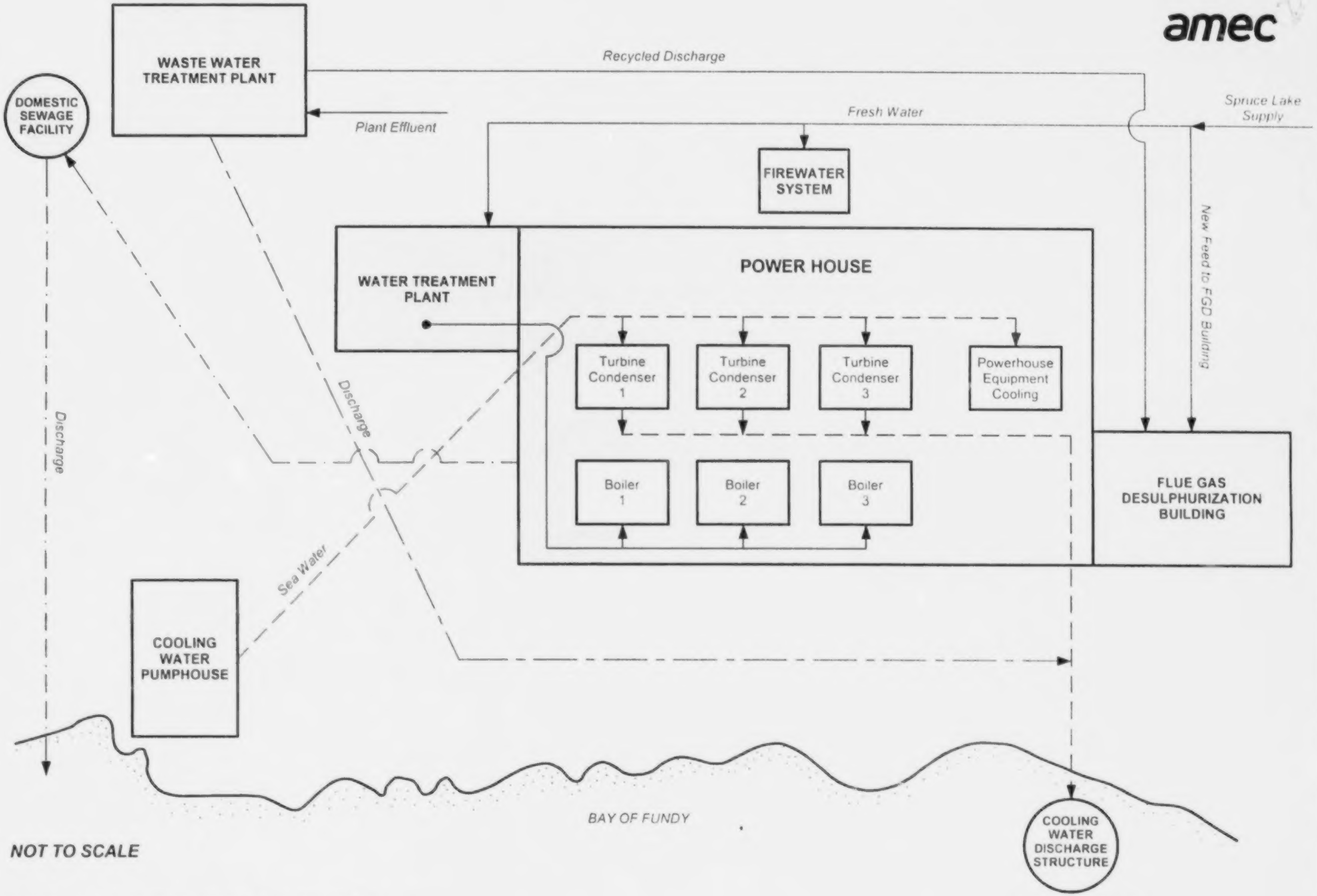
WASTE WATER TREATMENT PLANT
DOMESTIC SEWAGE FACILITY
Recycled Discharge
Plant Effluent
Fresh Water
Spruce Lake Supply
FIREWATER SYSTEM
WATER TREATMENT PLANT
POWER HOUSE
Turbine Condenser 1
Turbine Condenser 2
Turbine Condenser 3
Powerhouse Equipment Cooling
Boiler 1
Boiler 2
Boiler 3
New Feed to FGD Building
FLUE GAS DESULPHURIZATION BUILDING
Discharge
Discharge
Sea Water
COOLING WATER PUMPHOUSE
BAY OF FUNDY
COOLING WATER DISCHARGE STRUCTURE

NOT TO SCALE

SOURCE: Modified After NB Power, May 2002.

TE21092/water systems (2002/06/06)

FIGURE 4.4
FRESH and SEA WATER SYSTEMS
COLESON COVE REFURBISHMENT PROJECT

Based on the predictions of the CCCMA models, average annual precipitation in the area of these watersheds will not decrease, and may even increase. As a result, the ability of the reservoirs to reach their maximum storage capacities by the start of the summer months will remain unchanged or even increase. In terms of the effects of summer evaporation rates on reservoir levels, the predicted increase of 20% is not considered sufficient to eliminate the head that is typically available in the Loch Alva reservoir at the end of the summer season.

4.3.9 Wastewater Treatment Plant

The WWTP will be a fully integrated process designed to treat the wastewater from the boiler, FGD, ash, gypsum and limestone handling systems, tank farm dyked area (as necessary) and leachate from the generating station solid waste landfill site (as necessary). The treatment process will be capable of treating the unique characteristics of the wastewater resulting from Orimulsion® fuel, using similar proven process technologies employed at the Dalhousie Generating Station. Design and operation of the WWTP facility will be carried out in accordance with the Environmental Codes of Practice for Steam Electric Power Generation and will be compliant with the effluent criteria established by the NBDELG.

The design of the wastewater treatment process will be based on:

- control of pH (neutralization of acidic wastewater);
- complexation and co-precipitation of heavy metals (removal of soluble heavy metals);
- sulfate desaturization (reduce soluble sulfate);
- removal of suspended solids and ultrafine colloidal precipitates;
- coagulation and removal of trace organics (including heavy oil, lubrication/hydraulic oils and Orimulsion® fuel) from wastewater; and
- fixation of precipitates and solids residue to minimize the leachability of solids.

As shown in Figure 4.5, the stages of wastewater treatment (unit operations) will include:

- Equalization Basins
- Neutralization Reactor
- Clarification
- Polishing Filter
- Solids Dewatering
- Surge Basin
- Orimulsion®/ Water Separation
- Oil/Water Separation

Most of the treated wastewater will be recycled to the FGD circuit and used as service/recycle water.

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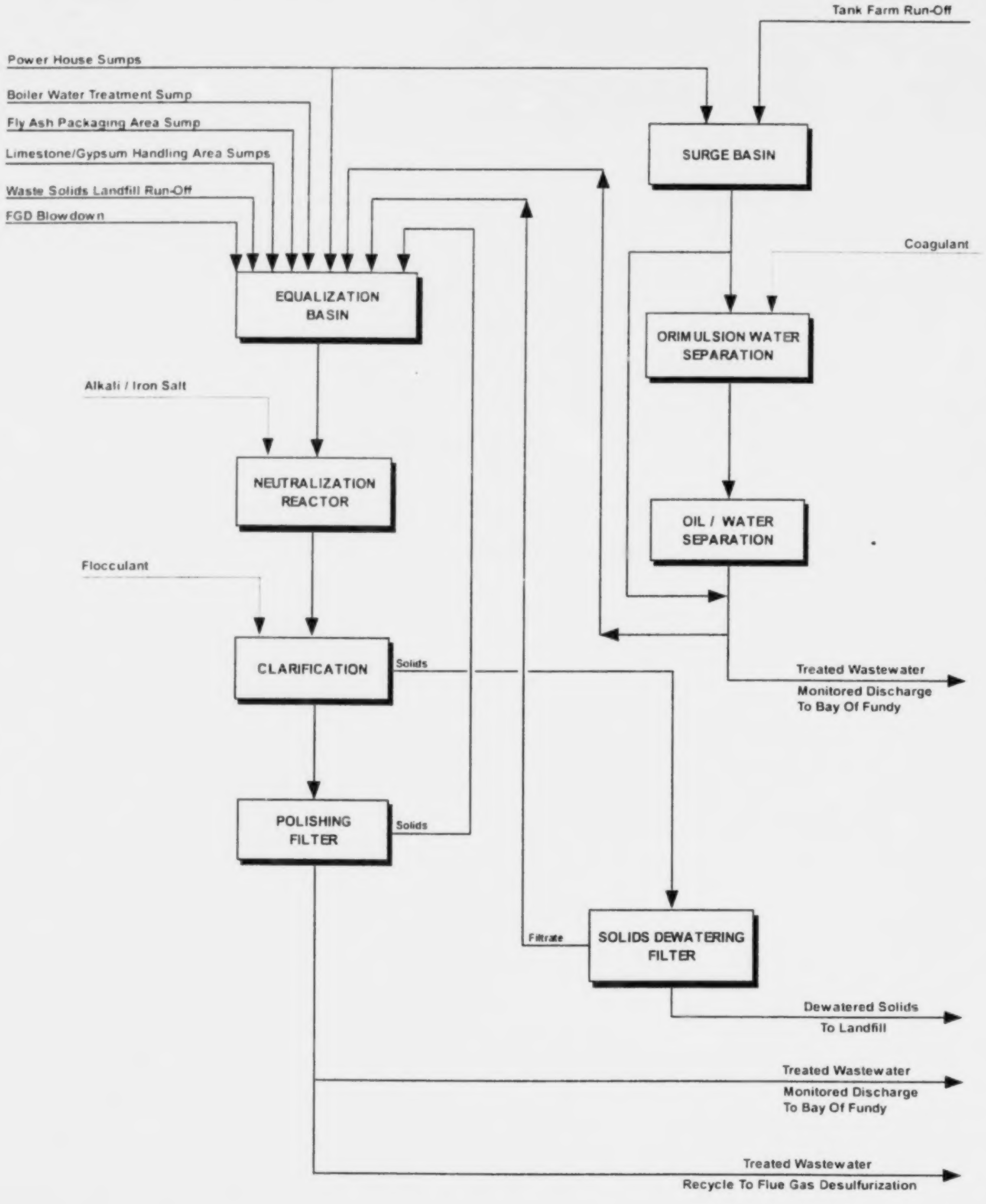
Tank Farm Run-Off
Power House Sumps
Boiler Water Treatment Sump
Fly Ash Packaging Area Sump
Limestone/Gypsum Handling Area Sumps
Waste Solids Landfill Run-Off
FGD Blowdown
SURGE BASIN
Coagulant
EQUALIZATION BASIN
ORIMULSION WATER SEPARATION
Alkali / Iron Salt
NEUTRALIZATION REACTOR
OIL / WATER SEPARATION
Flocculant
CLARIFICATION
Solids
Treated Wastewater
Monitored Discharge To Bay Of Fundy
POLISHING FILTER
Solids
Filtrate
SOLIDS DEWATERING FILTER
Dewatered Solids
To Landfill
Treated Wastewater
Monitored Discharge To Bay Of Fundy
Treated Wastewater
Recycle To Flue Gas Desulfurization

FIGURE 4.5
STAGES OF WASTEWATER
TREATMENT

Since the FGD needs constant make-up water, it is expected that all the flow from the WWTP would be recycled back into the FGD. However, during an outage on one or other FGD, less make-up water would be required, and wastewater could be generated from other plant activities. This water would have to be discharged, after treatment and monitoring, in accordance with the COA.

4.3.10 Land Acquisition and Site Improvements

The construction of a new solid waste disposal area will require land acquisition by NB Power. Some space will also be required for the construction activities (parking lot and a laydown area for material receiving).

The site is within the existing Lorneville Industrial Park, an area of 3240 ha (designated for industrial development). Within the industrial park area, NB Power has ownership of 328 ha, of which 30 ha has been developed for the CCGS.

The Project will require the purchase of 88 ha of adjoining property from Business New Brunswick. This required property is bordered by the station tank farm, Burchill road, the station supply pipeline and the Bay of Fundy.

The Project will require the development of land areas within the NB Power property during construction and during operation. During construction, the following areas will be required:

- On the existing property
  - Construction trailer site 0.2 ha
- On the new property
  - Temporary parking – 2.0 ha

During Operation, the following areas will be required:

- On the existing property
  - Gypsum and limestone loading area – 0.2 ha
- On the new property
  - Laydown area (developed for construction, used during Operation – 3.25 ha
  - SWSDA – 6.0 ha.

The total area to be developed is 11.65 ha.

Due to the higher demand of fresh water required by the Project, a new fresh water line will be required to handle the extra capacity needed. A 400 mm underground line will be installed between the city main, which is located near the entrance ot the plant property and the plant buildings.

The dual fresh water supply lines (the existing 450 mm and the new 400 mm) will improve the safety and reliability of the plant.

A new access road will also be built to accommodate site traffic around the new plant structures. Care will be taken to provide adequate drainage and erosion control. The yard for the truck hauling operation will be fenced and yard lighting will be installed to ensure safety and security.

4.4 Construction

NB Power has committed to being consistent with Environment Canada's Codes of Practice for Steam Electric Power Generation – Construction Phase (Environment Canada, 1989). In addition, NB Power will require a COA to Construct under the *Water Quality Regulation* of the *Clean Environment Act*. The application for the Approval to Construct will include specific details of the layout, erosion and sedimentation control plans, and detailed site drawings.

A site-specific Environmental Protection Plan (EPP) will be prepared that will address all the applicable sections of the Codes of Practice. Some recommendations in the Codes relate to a green field site, whereas this is already a fully developed industrial facility with access roads and related infrastructure.

In general terms, the construction phase will require temporary construction offices, parking areas, and laydown areas. These will generally be located in areas used when the CCGS was originally constructed.

Where new areas are to be developed, such as the new WWTP, the EPP will identify measures to control erosion and sedimentation.

4.4.1 Construction Schedule

The construction schedule has to allow for the ongoing operation of the CCGS during the winter months, since the energy is required to supply in-province loads between approximately October and March. The preliminary schedule is shown in Table 4.13.

TABLE 4.13 Preliminary Project Schedule

Action	Date
Onsite work starts	2002
First unit converted, continues on oil until August 2004	2003
Second and third units converted	2004
First shipment Orimulsion®	Spring 2004
Begin FGD commissioning on Orimulsion®	August 2004
FGD In Service	November 2004
Plant fully commissioned	November 2004

The station will be fully operational, using Fuel Oil #6, in the winter of 2002 and 2003, and construction will be managed accordingly.

4.4.2 Construction Labour Requirements

The conversion of the CCGS to burn Orimulsion® and the construction of the FGD system will require a broad range of labour skills. It is estimated that between 3 and 5 million person hours of labour will be required over the period of the Project.

It is intended to have a labour stabilization agreement for the Project to ensure that, where appropriate, the labour will be supplied through the local unions.

The site facilities will include all the required infrastructure to handle the construction workforce, and it is expected that non local labour will find short term accommodations in Saint John and the surrounding area.

4.4.3 Construction Facilities

During construction, some temporary facilities and structures will be required.

It is planned that all the accommodations for temporary offices, workers change room, lunchroom, first aid facilities and washroom will be in the form of modular construction trailers. For the temporary washroom trailers, sewer holding tanks will be provided. Emptying of the sewage tanks will be done on a regular basis, by a licensed waste management contractor. When the construction is completed, all of these facilities will be removed from the site.

A temporary parking lot will be required to accommodate the large amount of construction labour force. The plan is to use the area east of the limestone/gypsum building for the first two years. This area was previously used for the same purpose during the original plant construction. For the third year of the Project, construction of the truck access yard and truck scale will make it necessary to relocate the parking in a new area east of the first parking lot.

A temporary laydown area will be required to receive the construction material needed for the Project. There is a 150 m x 200 m area east of the tank farm, on the north side of the plant access road, previously used during the original plant construction. This site is already cleared and is well suited for material storage. Fencing and lighting will be installed on the perimeter of the area to improve security. Some electrical parts and other material will need to be stored with protection from the weather. To address this issue, a storage warehouse will be erected within this laydown area. The structure will be a pre-engineered building of approximate dimensions of 24 m by 43 m by 9 m high. Half of the building will be heated. After the construction phase, NB Power will use it as a storage facility.

Similarly, the NB Power laydown area on the south side of the 345 kV switchyard will be made available for the storage and pre-welding of the new boiler parts.

Prefabrication of the FGD absorber and the WESP modules will be done in the new limestone/gypsum building. The design of this building will accommodate this activity.

4.5 Operation

NB Power operates its Point Lepreau, Belledune, Grand Lake and Dalhousie Generating Stations as year round base load facilities. This means they operate at or near their full capacity throughout the year, except for maintenance outages. Hydro generation is utilized for daily peak generation except in the high water periods of spring. In that period, hydro stations are operated as base load generation and other stations are taken out of service for annual maintenance.

The three 350 MW gross units at CCGS provide much of the spring/fall and winter seasonal load requirements for the system. The CCGS is often used in coordination with the hydro generation to meet daily load swings. In the winter, usually two or three units operate. At other times of year, particularly summer, one or two Coleson units typically operate. The number of units operated is dependent on system load requirements, New England market opportunities and the availability of energy from Hydro Quebec. As a result of these factors, the operation since 1990 has varied, as shown in Table 4.14. In the future, the CCGS is predicted to operate with a capacity factor about 65%. In theory, it could operate with a capacity factor as high as 85%, which would result in a reduced capacity at the base load facilities.

Past and predicted annual emissions are summarized in Table 4.14. The past emissions reflect the capacity factor in the past, while the predicted emissions are given for both a 65% and 85% capacity factor. Actual capacity factor cannot be predicted since it depends on many other variables including weather and the price of different fuels. The capacity factors that are used here (65% and 85%) are considered to be the "most likely" and "highest predicted" capacity factors for the CCGS in the future.

TABLE 4.14 Annual Air Emissions for CCGS

Year	Capacity Factor	SO_2 (kt)	NOx (kt)	Particulate (kt)	CO_2 (Mtonnes)
Actual					
1989	67.7	74.0	22.6	4.3	4.6
1990	52.6	58.5	17.9	3.92	3.68
1991	53.3	55.8	18.2	1.0	3.75
1992	54.7	63.9	21	1.2	4.2
1993	45.7	50.5	15.7	0.87	3.32
1994	37.4	40.5	8.5	0.3	2.61
1995	27.4	29.6	6.5	0.23	1.89
1996	13.5	14.2	2.5	0.12	0.99
1997	44.6	46.5	10.1	0.5	3.03
1998	56.7	61.2	17	0.63	3.85
1999	41.7	47.8	12.1	0.48	2.88
2000	53.5	56.9	15	0.95	3.71
2001	65.6	65.1	18.6	1.47	4.45
Predicted					
Future (most likely)	65	15.9	5.6	0.27	4.33
Future (highest predicted)	85	20.8	7.3	0.35	5.66

The total CO_2 generated after refurbishment, including the CO_2 from running the control equipment and the chemical reaction from the limestone is calculated to be in the order of 4.33 million tonnes at 65% capacity factor and 5.66 million tonnes at 85% capacity factor. For comparison purposes, emissions for 2001 were 4.45 million tonnes at a capacity factor of 65.6%.

4.5.1 Labour Requirements

The existing CCGS employs 99 people, with an increase in staff during annual maintenance activities. The new systems will require an increase in staff to approximately 103 people in total, and there will be a slight increase in the requirements during annual maintenance activities.

These extra jobs, and the increased maintenance activities, will create further economic and indirect benefits during the life of the CCGS.

4.6 Decommissioning

The anticipated life of the Project is 25 years. As the facility approaches this situation, a review will be undertaken to determine the future of the facility. This could include a refurbishment project (such as the current proposal), or closure and decommissioning. That decision would be made in time to complete the process in an orderly manner, while ensuring the continuing supply of reliable electricity to customers.

Should the decision be made to close the CCGS, a decommissioning plan would be developed and submitted for approval by regulatory agencies, including NBDELG. Once approved, the plan would be implemented with the cessation of operations at the facility.

The decommissioning plan would address plant take down, equipment/material disposal/ recycling, site stabilization and remediation, as well as the secure closure of the solid waste facilities on site. The closure process would also include any appropriate continuing treatment of wastewater, as well as environmental monitoring post closure, with respect to drainage from the solid waste facilities, for example.

4.7 Safety and Contingency Planning

Spill Response

NB Power has signed a Memorandum of Understanding (M.O.U.) with Bitumenes Orinoco, S.A. (Bitor) of Venezuela to enter into a 20 year contract for the supply of Orimulsion® for the CCGS. Bitor has made a number of their own Corporate commitments related to the safe shipment of Orimulsion® that go beyond legal requirements. These include commitments related to spill prevention, and to spill response plans.

NB Power will comply with these commitments.

The key components of Bitor's commitment to prevention of spills include:

1. Orimulsion® Tankers must be double hull design as defined by IMO's International Convention for the Prevention of Pollution from Ships (MARPOL).
2. Tankers must be classed by a member of the International Association of Classification Societies (IACS).
3. Tankers will be 15-years of age or younger.
4. Tankers must be entered with a member of the International Group of Pollution and Insurance (P&I) Clubs.
5. Tankers must be registered with a flag state that has a demonstrated history of enforcing international shipping conventions. Tankers must be inspected and accepted by the PDV Marina's Tanker Vetting System.
6. Tankers will have as a minimum a rating of 3 in the current year's "Guide for the Selection of Tankers", Tanker Advisory Center, by Arthur McKenzie.
7. Tankers must have a minimum of four deck officers (in addition to the Master). All should be orally proficient in the English language and the language spoken by the crew.

In addition, Canaport Limited, the Terminal Operator in Saint John, New Brunswick has well established rules, procedures and guidelines for operational safety such as ship vetting, cargo handling, and monitoring of ships moored at the Canaport Monobuoy, tug escorting and assistance, and weather monitoring. All tankers transiting the Bay of Fundy to and from the Canaport and Courtenay Bay Terminals utilize an established Vessel Traffic Management system operated by the Canadian Coast Guard (CCG), which monitors a vessel's passage throughout the entire Bay of Fundy. This system monitors the approaches to and from the Canaport Monobuoy, all anchorages, and the Monobuoy itself, by radar and radio, 24 hours a day. The Vessel Traffic Management System is described in detail in the "Notices to Mariners – Annual Edition", Section 25, available from the CCG. At all times the vessels operating within the Vessel Traffic Management System utilize the Recommended Code of Nautical Procedures & Practices as laid down by Transport Canada Marine Safety in cooperation with the CCG.

All Orimulsion® tankers for the Project fuel delivery will be required to carry current versions of charts and publications, maintained in accordance with international requirements.

Bitor is committed to developing site-specific "Guidelines/Procedures for Orimulsion® Tankers Operating in Canadian Waters and the Port of Saint John", to cover the movement of ships on the approaches and within the Port of Saint John. This plan is being developed for Orimulsion® shipments into Saint John Harbour. It is being developed with input from key agencies such as CCG, Saint John Port Authority, Pilots, Harbour Master, Canaport operators, and others as appropriate.

NB Power will be obligated to comply with these commitments when contracting for fuel delivery.

In accordance with the Canada *Shipping Act*, the ship delivering Orimulsion® will be required to have a contract with the Atlantic Emergency Response Team (ALERT), the Certified Response Organization for the area, in order to enter Canadian waters.

ALERT, the Certified Response Organization, is required to have a response plan including procedures, personnel and equipment to allow it to respond to a spill. Orimulsion® spill-specific equipment will be available through ALERT. The legislation includes a requirement that the plan be exercised, and that training take place.

The Response Organization is required to submit its response plans to CCG, and to have its equipment list approved by the CCG as part of its on-going certification. The Canada *Shipping Act* includes specific time lines for response and these will be reflected in the response plans submitted to CCG.

In addition, the Oil Handling Facility Regulations under the Canada *Shipping Act* requires the operator of the Canaport monobuoy to have a spill response plan, and personnel and equipment to be able to conduct the initial response in the event of an incident at the monobuoy.

As part of the Project, NB Power and Bitor will be working with ALERT and the operator to identify response strategies, additional equipment, and training consistent with these requirements.

NB Power will own the fuel once it is loaded onto the ship. Responsibility for an accidental spill, will rest with the shipping company or the owner of the monobuoy depending on location and cause. In addition, legislation requires the ship owner and the monobuoy operator to have plans in place prior to the fuel delivery to appropriately respond to a spill.

Potential Emergency Situations

An on-site Health and Safety Plan is in place at CCGS. It addresses the safe handling of materials through use of WHMIS training, use of MSDS sheets, and designation of required Personal Protective Gear. Written work procedures apply to handling of designated materials.

Operation of the Project will involve the storage, handling and transport of materials which are hazardous or which can contaminate the environment if an uncontrolled release occurs. Written emergency response procedures are also in place and will be modified accordingly. Section 7.2 addresses the possible upset conditions which could lead to a discharge that is outside the design criteria for the facility.

The various new materials which will be on site are listed below, along with the applicable unit volumes that could plausibly be involved in an unplanned release:

- Orimulsion® - storage tanks, dyked to contain 110% of tank volume.
- Limestone - 40 tonne truck loads; reserve supply in bulk storage.
- Gypsum – in 40 tonne truck loads.
- Off spec gypsum – in 40 tonne truck loads.

- Waste water sludge (increased volume) – truck loads.

The key approach will be to prevent incidents.

The planning for response will be based on the potential release volumes from a single container of the listed materials. An adequate supply of containment, recovery, storage and disposal equipment will be maintained to deal with an event which results in the total loss from a container. A standing offer- type contract is in place with a licensed suction truck operator who can respond on a 24/7 basis. The site personnel will have adequate training, personal protective gear and communications capability to deal effectively with the incident. Training will include drills to simulate actual situations. Priority will be given to human health and safety, then to protection of the environment. Existing procedures will be revised as necessary to outline specific response actions – alert/warning, shut off source, contain, recover, transport and dispose. In most cases the SWSDA will receive recovered material.

4.8 Other Projects

Land use surrounding the Project, included in parts of this assessment, consists of the existing Maritimes and Northeast Pipeline (M&NP) Project, ongoing forestry, and other NB Power projects.

These projects were selected because they could potentially act cumulatively with the Project in the following manner: direct habitat/land use loss, direct emissions sources, and sensory (noise) concerns. The identified projects and activities are described below:

Maritimes & Northeast Pipeline - Saint John Lateral Pipeline Project

This project within the Study Area involved construction and operation of approximately 110 km of 12" O.D. natural gas pipeline (*i.e.*, SJLPP). Construction and operation has been approved by the National Energy Board. A Comprehensive Study Report was prepared for the SJLPP. The work involved clearing of the full Right–of-Way (RoW) width and included in stream construction for stream crossings. SSEPPs were prepared for each stream crossing and detailed fish habitat maps were prepared for each crossing. All crossings were returned to a condition that met the requirements of the permits received. Monitoring of this work is continuing.

The SJLPP involved construction activity within wetlands. The RoW was routed so as to limit the amount of wetland habitat crossed and any wetlands crossed were rehabilitated following construction. This rehabilitation work is also the subject of an extensive monitoring program to confirm the success of rehabilitation.

Vegetation will be controlled on the SJLPP RoW through the use of mechanical harvesting.

Forest Harvesting Practices

Approximately 3,400 ha of the Study Area is forest cover all of which is privately owned. Forestry operations on private woodlots are not legislated, and do not require that a management plan be submitted to NBDNRE. Therefore, private woodlot operations do not have to adhere to habitat requirements set out by NBDNRE. As the future plans for the private woodlots are not available, it is extremely difficult to assess the cumulative effects the harvesting of these woodlots may have in conjunction with the Project. However, the majority of the Study Area has been cut historically, and has been converted to softwood plantations for the purpose of fibre production. Since the majority of these private woodlots are dominantly softwood, then the cumulative effects should be minimal as an ample supply of softwood habitat is available in New Brunswick. Therefore there should be no significant adverse effect on the species identified as VECs.

NB Power Projects

Project involved construction of 69 kV transmission line (line 42) from Canaport to Courtenay Bay Terminal in 1969. The transmission line is approximately eight km in length and required a 23 m RoW. The conductor is strung on H – frame wood pole structures. The poles are approximately 16 m in height. Inspection/maintenance on the transmission line will be conducted twice per year on an ongoing basis. Vegetation management is generally on five to seven year cycles. No pesticides are used for vegetation management. All vegetation control activities are carried out in accordance with NB Power's Environmental Protection Plan for Transmission Facilities and the Watercourse Alteration Permit from NBDELG.

The area which will be affected by the Project may be affected by the operations or activities of other projects in addition to construction and operation of the Project. Federal and provincial government departments have been consulted regarding proposed and ongoing activities in the region. The following is a summary of the projects and activities that have been identified. Certain activities may take place consecutively or concurrently with the Project. Some activities may already have affected the region, while others may be likely to take place in the future. Collectively, the following represents those projects or activities which may potentially act in combination with the Project. As such, these are being considered in this EA to the extent that they may contribute to the cumulative environmental effects of the Project.

- Refining
- Pulp and paper mills
- Electric power generation facilities
- Population trends/vehicle numbers
- Marine traffic
- LNG Terminal

4.9 Alternatives

The Guidelines require that a discussion be presented of Project Alternatives. This information provides a better understanding of the rationale for the Project, and will assist decision makers in determining the acceptability of the proposed undertaking.

4.9.1 No Project

This alternative is intended to provide a consideration of the economic, environmental and social implications of not proceeding with the Project. The "No Project" alternative is defined as a continued operation of the CCGS without refurbishment. That would mean that the facility would continue in operation, and would continue to burn Fuel Oil #6 without any material change in the discharge characteristics of the various waste streams.

The "No Project " alternative would have the following consequences:

- Continued volatility in fuel prices, and resultant uncertainty in rates
- Difficulty for the province to meet regional air quality commitments with regard to SO_2, NOx, and particulates, and
- Loss of economic benefits associated with Project construction.

For the purposes of this EA, the "No Project" alternative will be used to provide a basis for comparison with the Project, and to examine the incremental environmental effects of the Refurbishment Project. NB Power does not, however, consider the "No Project" alternative to be a viable option.

4.9.2 Alternative Projects and Fuels

The potential alternatives for the Project have been considered in detail by NB Power, and presented as evidence to the PUB (application dated July 12, 2001, evidence presented November 1, 2001). NB Power carried out extensive analysis to identify the best available alternative to meet the needs of the utility and of its customers. NB Power presented the results of these analysis to the PUB, and to the public, in order to answer three questions:

- Why does the CCGS have to be refurbished?
- What are the alternatives to refurbishment of CCGS?
- Why is the proposed refurbishment the best available alternative?

The first question addresses the need for the Project, and the following response explains why the "No Project" alternative is not acceptable.

The need for the Project is driven by the conditions of the present license to operate, which is issued to NB Power by the NBDELG. This license requires the company to submit a plan to reduce SO_2 emissions to 40,000 tonnes or less by 2005. As well, the NEG/ECP have targeted a 30% reduction in NOx emissions by 2007.

The CCGS is the largest generating station in the NB Power system, and it is currently fuelled by Fuel Oil #6. As a consequence, the facility is the largest source of air emissions on the NB Power system. Thus, in order to meet the emissions reduction requirement, changes must be made to the station. The proposal developed by NB Power for refurbishment, along with the planned closure of the Grand Lake Generating Station, will enable NB Power to meet the SO_2 reduction requirements. These actions will also reduce NB Power's NOx emissions by an estimated 40% from year 2000 actual levels of 25,800 tonnes.

The PUB Hearing addressed in considerable detail the alternatives available for the CCGS, and the evaluation process followed by NB Power in arriving at the recommended option. This process involved the identification of a broad range of supply options, including emerging technologies and non-traditional sources (*e.g.,* wind generation, fuel cells, small hydro). In evaluating these Alternative and Emerging Energy Options, it was noted that none of these are currently capable of meeting the criteria to qualify for detailed evaluation. A screening approach was used to make the comparison on an equitable basis (net present value) over the life cycle of each option. The screening also considered the extent to which each option could meet emission reduction requirements.

As a separate exercise, a life cycle analysis of greenhouse gases was conducted for fossil fuels (Golder, 2002b). The fuels evaluated included Orimulsion®, residual Fuel Oil #6, coal and natural gas, including LNG. The analysis included not only the combustion of fuels, but also their development, production, processing and transportation. For example, the use of natural gas at the CCGS site would require the construction of up to 595 km of new pipeline which would contribute to greenhouse gas emissions (and present other environmental issues). The contribution of these "non-combustion" activities varies with each fuel, but is in the range of 4% to 10%, so that the dominant consideration is the combustion stage of the life cycle. The results of the life cycle comparison produces the following ranking (with percent difference related to Orimulsion®:

• Coal	127%
• Fuel Oil #6	111%
• Orimulsion®	100%
• Natural gas - Steam	80%

Complete conversion of the CCGS to natural gas was, however, rejected at the screening stage. Direct gas conversion would result in a capacity deration of the CCGS due to heat losses. To overcome this deration, and meet power generation requirements, one of the units would need to retain the ability to run on Fuel Oil #6. As well, a boiler modification would be required. With this configuration, there would continue to be a reduction in efficiency when operating on natural gas. Operation totally on gas would be mainly from March to November, with oil supplementing gas during peak load months in Winter. The result would be an annual usage pattern in the order of 20% oil and 80% gas. Thus, the feasible options included natural gas as a "combined cycle" operation at Coleson Cove.

In total, fifteen power supply options which could replace energy supplied by the CCGS were identified. These 15 options were reduced to three through screening, based on economic viability and the ability to meet the anticipated emission standards for SO_2 and NOx. The feasible options for further detailed evaluation, were:

- Orimulsion® Conversion (The Project in this EA);
- Modified Existing Operation at Coleson Cove – Oil Blend with NOx Controls (continued use of the existing plant with blending of 1% and 3% sulphur Fuel Oil #6 for SO2 control and fuel reburn for NOx control); and
- New Combined Cycle Gas Unit at Coleson Cove (construction of a new 400 MW natural gas combined cycle unit, in combination with reduced operation of the existing Coleson Cove units with blended 1% and 3% heavy oil and fuel reburn capability).

Further analysis (using PROVIEW, a detailed power system planning program developed by New Energy Management of Atlanta, Georgia) confirmed that the Coleson Cove expansion plans are the three most reasonable choices. A detailed system integration analysis was carried out for the three Coleson Cove alternatives. It was concluded that the least cost alternative is the Orimulsion® Conversion. This cost advantage is maintained under a wide range of changing conditions. The Orimulsion® Conversion enables NB Power to cost effectively meet all projected future emission reduction targets.

The detailed analyses, including consideration of environmental factors, is provided in the record of the PUB Hearing.

This EA extends the consideration of alternatives by presenting a comparison between the "No Project" (existing situation) alternative, the "Natural gas" exclusively alternative, and "Orimulsion®". This comparison is presented in a manner consistent with the EA Terms of Reference. The focus of the evaluation of Human Health Effects Assessment is on a comparison between these three alternatives with respect to human health of area residents. The consideration of the Marine Ecosystem provides a comparative ecological risk assessment with respect to spills of Fuel Oil #6 and Orimulsion®. In addition, the following Table (Table 4.15) presents a summary of other issues related to generation alternatives at Coleson Cove.

LNG was considered as an alternative source of supply for the Project but was determined not suitable primarily because of NB Power's schedule to meet it's business commitments for the facility. The Project is scheduled for completion in November 2004. This completion date meets two business strategies required for the CCGS:

- Emission reduction strategies commitments with NBDELG by 2005.
- Energy replacement requirements to offset loss of the Point Lepreau Generating Station during it's refurbishment.

LNG facilities are being considered for the Saint John area but these plans are still in the development stage and would not meet the NB Power schedule requirements for the Project.

TABLE 4.15 Comparison of Generation Alternatives at Coleson Cove[1]

Factors Impacted by Choice of Fuel	Current Fuel Oil #6 (with NOx Control and blended fuel)	Orimulsion® Project	Natural Gas exclusively
Operation Efficiency	No Change	Small efficiency gain	• Reduction in efficiency • Cost efficient for only low capacity peaking services
Equipment Installation / Upgrades	• Generator rewind • Boiler and plant repairs to ensure reliability • Low NOx burners and reburn capability to control NOx emissions • Upgrade of Distributed Control System • Complete capital repairs to correct problems that are causing current derations	• Boiler modifications • Upgrade the Distributed Control System • New fuel offloading facility • New pipeline Generator rewind • Flue gas desulphurisation (scrubber) • Low NOx burners and fuel reburn capability WESP to reduce SO_3 and particulate emissions	• Installation of low NOx burners and reburn capability capability to control NOx emissions • Upgrades to Distributed Control System • Upgrade boiler surface to achieve rated capacity.
Air Emissions	Does not meet current standard for SO_2 but meets current NOx and PM standard. It does not meet proposed future standards for SO_2 or PM. Where they are not new units and significantly improved emissions control measures will be implemented for NOx, this fulfils condition 2(2) of the existing and proposed Federal Thermal Power Generation Emissions- National Guidelines for Stationary Sources concerning NOx. Emissions are: SO_2 – 2.63 lb/MMBtu NOx – 0.21 lb/MMBtu PM – 0.045 lb/MMBtu	Meets current standards and where they are not new units and significantly improved emissions control measures will be implemented, this fulfills condition 2(2) of the existing and proposed Federal Thermal Power Generation Emissions – National Guidelines for Stationary Sources. Emissions are: SO_2 – 0.60 lb/MMBtu NOx – 0.21 lb/MMBtu PM – 0.01 lb/MMBtu	Meets proposed future standards for SO_2 and PM. Where they are not new units and significantly improved emissions control measures will be implemented for NOx, this fulfils condition 2(2) of the existing and proposed Federal Thermal Power Generation Emissions – National Guidelines for Stationary Sources concerning NOx. Emissions are: SO_2 – 0.0006 lb/MMBtu NOx – 0.15 lb/MMBtu PM – 0.001 lb/MMBtu

TABLE 4.15 Comparison of Generation Alternatives at Coleson Cove[1]

Factors Impacted by Choice of Fuel	Current Fuel Oil #6 (with NOx Control and blended fuel)	Orimulsion® Project	Natural Gas exclusively
Cost of Fuel	Expected increase in price due to future utilization of 1% sulphur fuel oil (if available) to meet emission reduction objectives and volatility of fuel oil prices	Stable Prices	Volatile price; unpredictable over the life of the Project.
Net Present Value - Cost	$400 Million more than Base Case	Base Case	$1200 Million more than Base Case
Construction	No additional construction required outside the CCGS. Would require additional landfill cells in future	• Upgrade of CCGS to burn new fuel • Construction of new pipeline from Canaport to east Saint John • Permanent RoW width of 9 m. • Temporary work areas in locations near watercourse and road crossings. • SWSDA • Fuel receiving and storage areas at Canaport • Pumping/booster stations. • Cathodic protection systems and facilities.	This alternative would require construction of new pipeline from Goldboro, NS to Coleson Cove. This assumes that there is sufficient gas supply and availability to operate the CCGS for the life of the Project. It is assumed that this construction involves twinning of the mainline to the Saint John Lateral Take-off (~510 km), and then follows the Saint John Lateral RoW to Ludgate Lake (~80 km), clear new RoW from Ludgate Lake to Coleson Cove (straight line ~ 5 km). Therefore a pipeline distance of up to 595 km. The pipeline would consist of a 30-inch diameter pipe, a 3 m wide trench, with a minimum of 1.5 m of cover over the pipe
Environmental constraints crossed by new construction	None – all construction would occur within the CCGS.	See Below	See Below
Terrestrial Environment[2,3]:			
No. of ESAs	N/A	0	Unknown
Archaeology	N/A	3.5 km	26.3 km
Wetlands	N/A	0.002 km^2	0.1 km^2
Agricultural land (all types)	N/A	0	11.5 km
Permanent Sample Plots	N/A	0	0
No. of Watercourses	N/A	5 watercourses	~400 watercourses

TABLE 4.15 Comparison of Generation Alternatives at Coleson Cove[1]

Factors Impacted by Choice of Fuel	Current Fuel Oil #6 (with NOx Control and blended fuel)	Orimulsion® Project	Natural Gas exclusively
Plantations	N/A	0	7.5 km
Water Supply Areas	N/A	~50 m through Zone B (exact delineation is not known, this is worst case)	6.1 km
Parks/Reserves	N/A	0	0
Deer Wintering Area	N/A	0	41.9 km
Mature Coniferous Forest Habitat	N/A	0	23.7 km
Mineral/ Petroleum Claims	N/A	0	42.8 km
Marine Environment[2]	Refer to accidental spills, below.	Refer to accidental spills, below.	There would be no environmental issues with the marine ecosystem as the pipeline would be completely terrestrial.
Human Health	SO_2 concentration of 18 ug/m^3 in Saint John. $PM_{2.5}$ - 9.0 μg/m^3 NO_2 - 14.5 μg/m^3 PM_{10} - 14.0 μg/m^3 Carcinogenic and non-carcinogenic risks are well below regulatory levels	SO_2 concentration of 17.5 μg /m^3 in Saint John. $PM_{2.5}$ - 8.995 μg/m^3 NO_2 - 14.4 μg/m^3 PM_{10} - 13.99 μg/m^3 Carcinogenic and non-carcinogenic risks are well below regulatory levels	SO_2 concentration of 16.5 μg/m^3 in Saint John. $PM_{2.5}$ - 8.988 μg/m^3 NO_2 - 14.2 μg/m^3 PM_{10} - 13.98 μg/m^3 Carcinogenic and non-carcinogenic risks are well below regulatory levels
Accidental Spills	Three marine mammal species at risk, 8 marine fish species, 6 seabird species, 1 shorebird species, 3 marine invertebrate species and 5 shellfish species of ecological/social importance are at risk due to accidental spills. Less time for reaction to clean-up and protection of sensitive habitats because it is wind driven, high aromatics (more toxic), substantial	Three marine mammal species at risk, 8 marine fish species, 6 seabird species, 1 shorebird species, 3 marine invertebrate species and 5 shellfish species of ecological/social importance are at risk due to accidental spills. More time for reaction to clean-up and protection of sensitive habitats because spills are current driven, few aromatics (less toxic), less harm expected to seabirds (less oiling of	There is no threat of spills along the natural gas pipeline, however, minor leaks of methane may occur at above ground facilities, such as at valve sites. Methane has an ignition temperature of 540° C and is flammable at concentrations between 5 and 15 % in air. Unconfined mixtures of methane in air are not explosive, however, a flammable concentration within an enclosed space in the presence of an ignition source can explode.

TABLE 4.15 Comparison of Generation Alternatives at Coleson Cove[1]

Factors Impacted by Choice of Fuel	Current Fuel Oil #6 (with NOx Control and blended fuel)	Orimulsion® Project	Natural Gas exclusively
	harm to seabirds (high amount of oiling of feathers), higher likelihood of a larger spill and a spill to occur since approximately only 5% of vessels that are transporting Fuel Oil #6 are double-hulled.	feathers), reduction in spill amounts and likelihood due to transportation by all double-hulled vessels.	Fugitive emissions, as well as those from maintenance activities will be rapidly dispersed to non-detectable levels. No effects on marine ecosystem.
Potential Commercial By- Products	Ash sold for vanadium recovery	Ash for vanadium recovery. Gypsum sold for wallboard production	None
Socio-Economic Operations	No change	Increase of 4 direct jobs, plus spin off to transport jobs increased maintenance	Loss of jobs relative to today
Socio-economic construction	Relatively small	Large	Large
Freshwater Usage	3,456 m^3/day	7,776 m^3/day	Up to 3,456 m^3/day
Trucking Requirements	None	425 trucks/week	None

Notes:

1. Please note that any of these Projects can be constructed in an environmentally acceptable manner with the implementation of appropriate mitigation.
2. The distances for the Natural Gas Option were taken from the following sources:
   Maritimes and Northeast Pipeline, 1998. Environmental Protection Plan (Mainline). Revised October, 1999.
   Maritimes and Northeast Pipeline, 1998. Constraint Mapping (Mainline). August.
   Maritimes and Northeast Pipeline, 1999. Environmental Protection Plan (Saint John Lateral Pipeline Project). May.
   Maritimes and Northeast Pipeline, 1998. Proposed Saint John Lateral Pipeline Project: Route Selection and Environmental Impact Assessment Study Report. June.
3. The distances for the Orimulsion® option were taken from the following report: AMEC, 2002.Fuel Delivery System Environmental Assessment Report: Coleson Cove Refurbishment Project. Prepared for NB Power. April.

4.9.3 Alternative Fuel Delivery Options

In the planning stage, there were three alternatives considered in Saint John Harbor for receipt of Orimulsion® fuel. Each alternative was evaluated on their different commercial, financial, technical and environmental implications. These three options have been presented at information sessions hosted by NB Power:

1. Existing monobuoy at Canaport in Saint John Harbour, located off Red Head, east of Saint John;
2. Develop unloading terminal at Port of Saint John, specifically at Pier 10; and
3. Develop a new monobuoy directly off the coast at CCGS.

Early in the evaluation process, it was recognized that Option 3 was the most expensive and would not support such an investment, as it would be under-utilized as a single user facility. It would also have difficulty in meeting the construction schedule for the Project.

Options 1 and 2 both have the advantage of using previously developed areas. Both require commercial operating agreements with current owners, both allow use of existing facilities, both require investment for new storage tanks, and both require a section of new on-shore pipeline to connect to existing facilities.

Option 1, the existing monobuoy at Canaport was selected as the preferred option to best satisfy the selection criteria and the commercial, financial, technical and environmental implications.

4.9.4 Alternative Pollution Prevention Technologies

The Project will realize major reductions in emission rates. These reductions will result from the installation of air pollution control technologies to reduce NOx emission rates by approximately 70%, reduce SO_2 emission rates by approximately 77% and reduce particulate emission rates by approximately 75%.

NB Power has worked with specialists and equipment suppliers to select the best combination of control technologies and to achieve each of the target emission rate reductions. The selected control technologies are:

- A wet flue gas desulphurization (FGD) system will be installed to control emissions of SO_2;
- Modifications to the burner system will be made that will include the addition of low NOx burners, reburn, flue gas recirculation and over-fire air to control emission of NOx;
- A wet ESP will be installed to control emissions of SO_3, a major component of fine particulate, exiting the FGD system.

These technologies are considered well proven and are commercially available.

FGD with forced oxidation is an available and demonstrated emissions control technology to limit SO_2 emissions. This technology is an appropriate application for the Project, and NB Power has good experience with this technology at the Dalhousie Generating Station and Belledune Generating Stations.

A WESP is an appropriate technology that can limit SO_3 emissions to meet the target levels at Coleson Cove. Such controls have been demonstrated to reduce acid mists and are especially applicable for wet exhaust streams such as after a wet FGD system.

Combustion controls that limit the formation of NOx emissions in the combustion process, in effect "pollution prevention", are available and demonstrated. Such "pollution prevention" controls have been demonstrated on fossil steam units firing coal, liquid fuels (Orimulsion® and Fuel Oil #6), and natural gas. This technology is an appropriate application for the Project.

NB Power is committed to, and believes that it is meeting all applicable standards by selecting a NOx emission rate of 0.21 lb/MMBtu through the use of this technology.

The Project will meet and do better than the existing guideline of 0.26lb/MMBtu, as stated in the Thermal Power Generation Emissions - National Guidelines for New Stationary Sources. This in spite of the fact that the Guidelines are intended to apply to new units only, and Coleson Cove is not a new source.

As noted in Section 7.9.2.3 of the EIA Report, Section 2(2) of the National Guidelines state that opportunities to reduce nitrogen oxides may arise during major alterations to an existing fossil fuel fired steam generating unit and improved NOx control measures. In fact, it will result in a significant reduction of 70%. Therefore, by selecting the emission rate of 0.21 lb/MMBtu, the Project is in compliance with Section 2(2) of the National Guidelines.

It is also noted that the air quality modelling does not predict any exceedences of any ambient air quality standards, including NOx.

One alternative technology for NOx control which was not selected for the Project is an ammonia based Selective Catalytic Reduction system (SCR).

Such a system has issues associated with it as follows:

- On-site storage of ammonia
- Trucking from out-of-province
- Ammonia slip (atmospheric release)
- Worker safety
- Wastewater treatment
- Gypsum/Ash marketability
- Plume visibility
- Catalyst management

- Reduced efficiency

These issues and their associated risks could be addressed, although there are technical concerns and uncertainties associated with several of them. Also, these issues would have a significant impact on capital and operational costs and schedule.

Based on the above, NB Power considers the proposed NOx emission control strategy to represent the best practical technology for the CCGS.

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5.0 ENVIRONMENTAL SETTING

This section provides a description of the environmental (biophysical and socio-economic) setting for the Project Study Area (Figure 5.1) located in Saint John County, New Brunswick. The description includes those components of the environment potentially affected by the Project. This description has been prepared from available information, relevant mapping, and discussions with government representatives, resource managers, and other stakeholders.

This description has been prepared to provide information on environmental components which may potentially be affected by the Project, or which may influence or place constraints on the execution of Project-related activities.

5.1 Study Area Definition

The selection of the Study Area was based on:

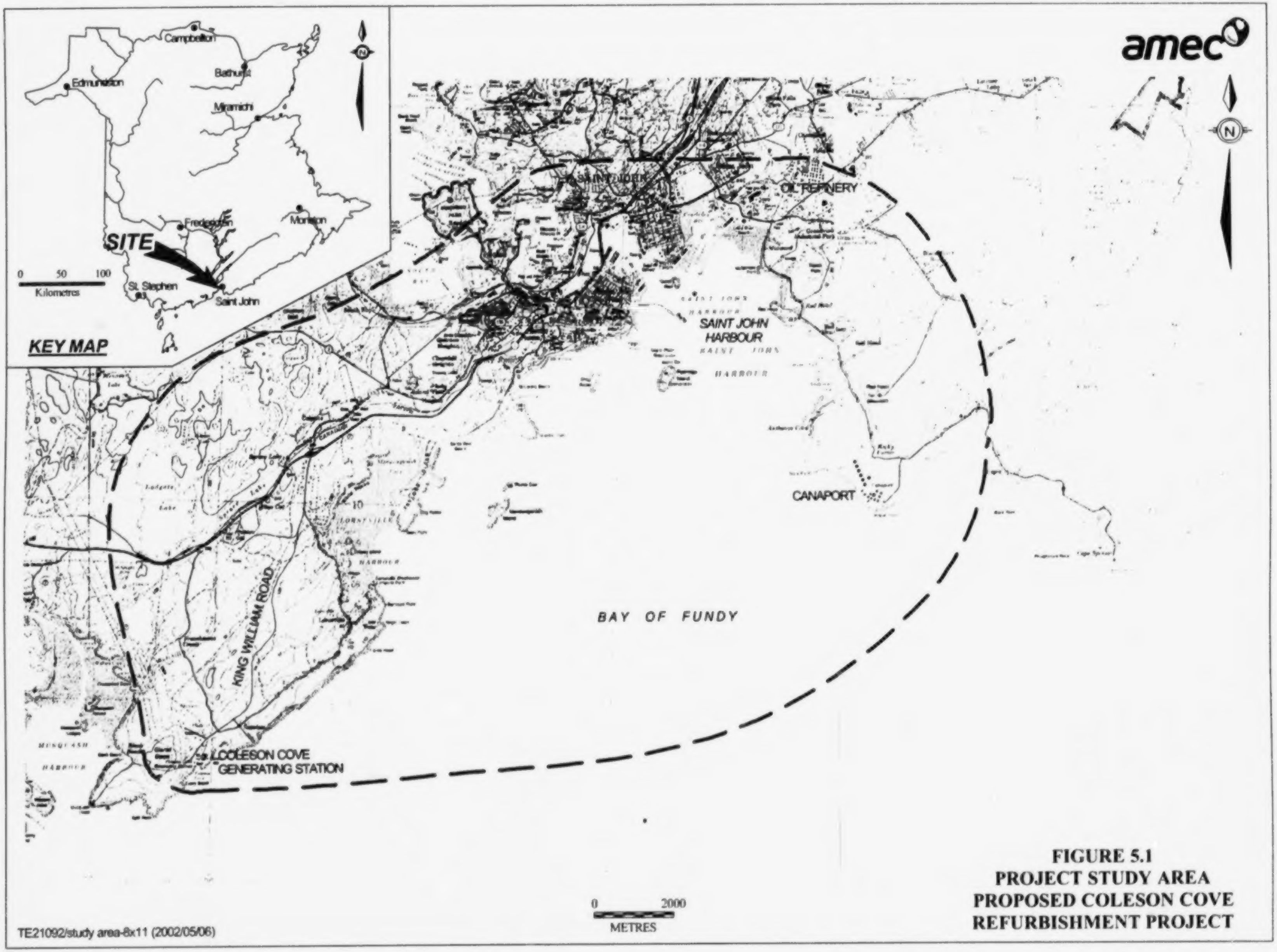
- the location of the CCGS and fuel delivery facilities;
- input from the Project proponent (NB Power); and
- environmental features in proximity to the CCGS and fuel delivery system.

Each Component Study Report has identified a specific Study Area (*i.e.*, CERA Report is comprised of the inner and outer Bay of Fundy, including both offshore and shoreline habitats; the Air Quality Study includes a square grid of 40 km per side, with the CCGS at the centre). However, for EIA purposes, the Study Area is general in nature and extends from the Black River Road in Saint John to Coleson Cove (see Figure 5.1), including Saint John Harbour and Outer Bay area. The Study Area is bounded to the north by the Irving Oil Refinery, and then heads west to Blue Point. From Blue Point, the Study Area boundary extends in a southwesterly direction through Crow Mountain, then between Menzies Lake and Ludgate Lake. At this point the Study Area boundary continues in a southerly direction along the western edge of Ludgate Lake and then east of Cheeseman Beach, continuing to Giants Steps and Evans Beach. Evans Beach is the southern most point of the Study Area. From Evans Beach, the boundary extends eastward to Mispec Bay, through Outer Bay of Fundy. The southern boundary of the Study Area through Outer Bay falls south of the Canaport monobuoy. From Mispec Bay, the boundary approximately follows the Saint John City limits in a northerly direction and then heads in a northwest direction east of Black River Road, before reaching the Irving Oil Refinery.

The following sections describe the environmental (biophysical and socio-economic) setting of the Project.

5.2 Atmospheric Environment

Components of the atmospheric environment, including climatology and the ambient air quality of the Study Area, are described below.


amec
Campbellton
Bathurst
Edmundston
Miramichi
Fredericton
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SITE
St. Stephen
Saint John
0 50 100
Kilometres
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SAINT JOHN
OIL REFINERY
SAINT JOHN HARBOUR
CANAPORT
BAY OF FUNDY
KING WILLIAM ROAD
COLESON COVE GENERATING STATION
MUSQUASH HARBOUR
0 2000
METRES

TE21092/study area-8x11 (2002/05/06)

FIGURE 5.1
PROJECT STUDY AREA
PROPOSED COLESON COVE
REFURBISHMENT PROJECT

5.2.1 Climatology

The description of climatology for the Study Area is based upon climate normals from the Saint John Airport Environment Canada weather station.

The Saint John Region is considered to have a modified continental climate. The Bay of Fundy and Lurcher marine areas west of Nova Scotia provide a strong moderation of air temperature over the region in both summer and winter. During the winter, the air mass is cold and unaltered with a January daily mean temperature of –8.2°C and in the summer, the air mass is predominantly warm continental with a July daily mean temperature of 16.9°C. The extreme maximum and minimum temperatures recorded are 34.4°C and –36.7°C, respectively.

The coastal areas of New Brunswick frequently experience fog that moves inland as a result of the merging of the warm Gulf Stream and the cold Labrador Current. The average annual precipitation in the Study Area is 1432.8 mm, of which 80% is in the form of rain. Extremes in daily precipitation occur in November and December and are in the range of 106 to 154 mm.

The sunshine hours from the Saint John Airport weather station are reported as 1893.7 hours per year. The highest amount of sunshine occurs in July with approximately 217.0 hours and the least amount of sunshine occurs during the month of December with approximately 97 hours.

The average annual wind speeds reported at the Saint John Airport weather station are 18 km/hour. The maximum wind speeds occur in March with average speeds of 20 km/h and the minimum speeds occur in August at an average of 14 km/h. The average monthly wind speeds are higher in the winter than the summer. The prevailing wind direction is south.

5.2.2 Ambient Air Quality

Air quality is influenced by the concentrations of air contaminants in the atmosphere. Air contaminants are emitted by both natural and anthropogenic sources and are transported and dispersed by wind.

Air contaminants eventually settle or are washed out of the atmosphere by rain and are deposited on vegetation, livestock, soil, water surfaces, and other objects. In some cases, contaminants may be redistributed into the atmosphere by wind.

The information in this section is based on results from monitoring stations near the Study Area, operated by the Air Quality Branch of the NBDELG, local industry, and Environment Canada. The parameters of concern that will be discussed in this section are total suspended particulates (TSP), inhalable particulates (PM_{10}), respirable particulates ($PM_{2.5}$), hydrogen sulphide (H_2S), carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), ground level ozone (O_3), and volatile organic compounds (VOCs).

Total Suspended Particulates (TSPs)

The term TSPs refers to those particulates in the air such as smoke, soot, and dust that remain suspended in the air and do not settle out readily. TSPs are a broad class of chemically and physically diverse substances that can either be in a solid or liquid state, or in combination. TSPs greater than 10 μm in size create problems such as visibility reduction, soiling, material damage, and vegetation damage. The TSPs become a potential hazard to health when the particle size is less than 10 μm in diameter. Such particles are commonly generated from building materials, combustion devices, human activities, and outdoor sources, including atmospheric dust and combustion emissions from mobile and stationary sources (WGA, 1995).

Annual TSP levels were recorded at the Provincial Building site in Saint John. NBDELG has set maximum acceptable limits of 70 μg/m^3 TSP (geometric mean) for an annual averaging period. The annual geometric mean was well below the standard for both 1997 and 1998. There were no 24-hour exceedences for either year. NBDELG stopped monitoring TSPs in Saint John after 1998.

Inhalable Particulates (PM_{10})

PM_{10} refers to matter with an effective diameter of 10 μm or less. The particles are termed "inhalable" because the particles are small enough to be inhaled via the mouth and some may enter the lungs (NBDELG, 2000). Particles of this size may irritate or otherwise have an adverse effect on the delicate membranes and air sacs which absorb oxygen. Other toxic effects may occur, depending on the chemical make-up of the fine particles (NBDELG, 2000).

PM_{10} in western Saint John is monitored by high volume samplers at the Hillcrest Church and Western District Police sites. There is no Canadian National Objective presently in place for PM_{10} and no provincial standard in New Brunswick. For reference purposes, the recorded levels are compared to standards in place in Greater Vancouver Regional District (GVRD), the United States, and the State of California (NBDELG, 2000).

The California and GVRD sets a 24-hour standard for PM_{10} at 50 μg/m^3 and a 1-year standard at 30 μg/m^3. In 1999, there were 10 occasions when levels were greater than 50 μg/m^3 - 6 at the Hillcrest site, and 4 at the Western District Police site. The majority of elevated values occurred in the fall and winter months and appear to have been regional-scale events when weather conditions caused poor dispersion and a resulting build-up of particulate matter. Extensive construction activity in the city may also have had an influence on the results (NBDELG, 2000).

Respirable Particulates ($PM_{2.5}$)

$PM_{2.5}$ refer to matter with an effective diameter of 2.5 μm or less, which bypass filtration in the nose and may be deposited in the lungs. These particles are thought to be of special significance in terms of health impacts, as they have a higher chance of entering and remaining in the lungs if inhaled, compared to PM_{10} or larger particles (NBDELG, 2000).

$PM_{2.5}$ matter in Saint John is recorded with a Tapered Element Oscillating Micro-Balance (TEOM) device operated at the Forest Hills site, in eastern Saint John. The agreed-upon Canada-wide standard for $PM_{2.5}$ is 30 $\mu g/m^3$ as a 24-hour average, itself averaged over 3 years (NBDELG, 2000). Therefore, it is only possible to determine compliance after a minimum of 3 years of recorded data. The recording of $PM_{2.5}$ data in Saint John was initiated in 1999 and reported information is only available for 1999. There were, however, no exceedences of the 24-hour average for $PM_{2.5}$ at the Forest Hills site in 1999 (NBDELG, 2000).

Hydrogen Sulphide (H_2S)

H_2S is a colorless gas with a characteristic smell of rotten eggs. Common sources of H_2S include pulp and paper mills, oil refineries, steel processing plants, natural gas plants, and sewage treatment plants (NBDELG, 2000).

H_2S is monitored at the Hillcrest site in west Saint John. The New Brunswick air quality standards for H_2S are 11 ppb for a 1-hour averaging period and 3.5 ppb for a 24-hour averaging period (NBDELG, 2000). There was one exceedence of the 1-hour standard and 20 exceedences of the 24-hour standard in 1999 at the Hillcrest site. All exceedences occurred during the month of May (NBDELG, 2000).

Carbon Monoxide (CO)

CO is formed from the incomplete combustion of carbon compounds. Major sources include motor vehicles, home heating systems, and refuse burning. Long-term trends indicate that CO levels appear to have been marginally lower between 1987 and 1992 compared with the years 1982 to 1985. This appears to be due to a general reduction in motor vehicle emissions (WGA, 1995).

The nearest CO monitoring station to the Study Area is located at the Customs Building in Saint John. Regulatory authorities in New Brunswick set CO guidelines of 30 ppm for a 1-hour maximum, and 13 ppm for an 8-hour maximum average, but have not yet adopted an annual average standard (NBDELG, 2000). Peak hourly values in every month were well below the applicable standard for 1999. There were also no exceedences of the 8-hour standard in 1999 (NBDELG, 2000).

Nitrogen Oxides (NOx)

NOx is released from the exhaust of combustion engines and furnaces. NOx is a compound that may be converted to NO_2. NO_2 plays an important role in the formation of O_3, by reacting with hydrocarbons in the presence of sunlight, and contributes to the formation of acid rain and smog (NBDELG, 2000). Ambient levels of NOx in New Brunswick are not believed to pose a risk to the environment (WGA, 1995).

The NO_2 monitoring station nearest to the Study Area is located at the Customs Building in Saint John. The air quality standards for NO_2 in New Brunswick are 400 $\mu g/m^3$ for a 1-hour averaging period, 200 $\mu g/m^3$ for a 24-hour averaging period, and 100 $\mu g/m^3$ for an annual averaging period. There were no exceedences of the 1-hour, 24-hour, or the annual standard at the Customs Building for 1999 (NBDELG, 2000).

Sulphur Dioxide (SO_2)

New Brunswick relies heavily on imported oil and local, or imported, coal supplies for energy production, transportation, industrial applications and space heating. Both of these resources contain sulphur as an impurity in various concentrations (WGA, 1995). SO_2 is often emitted as a result of burning sulphur-containing fuels, and by metal smelters and oil refineries. Emissions of SO_2 from motor vehicles are relatively minor (NBDELG, 2000).

The SO_2 monitoring station most representative of ambient conditions within the Study Area is located at the Hillcrest Church, west Saint John. The New Brunswick air quality standards for SO_2 in Saint John, Charlotte and Kings Counties are 450 $\mu g/m^3$ for a 1-hour averaging period, and 150 $\mu g/m^3$ and 30 $\mu g/m^3$ for a 24-hour and 1 year averaging period, respectively (NBDELG, 2000). There were no exceedences at the Hillcrest monitoring site of the 1-hour average, the 24-hour average, or the annual average for 1999 (NBDELG, 2000).

Ground Level Ozone (O_3)

Ozone (O_3) is a reactive, unstable form of oxygen. It is not directly emitted from smokestacks and exhaust pipes, but is formed as a result of a photochemical reaction between nitrogen oxides (NOx) and hydrocarbons or VOCs. The main contributors to O_3 include vehicle exhaust from cars and trucks and industrial emissions of NOx and hydrocarbons. A number of studies indicate the major contributor to ozone concentrations in Atlantic Canada appears to be the long range transport of contaminants from the northeastern US, especially the Washington to Boston corridor (NBDELG, 2000).

The nearest O_3 monitoring station to the Study Area is located in west Saint John, at the Hillcrest Church. New Brunswick currently has no standards in effect for O_3 concentrations.

The Canada Wide Standard (endorsed by CCME in June 2000) for ozone is 65 ppb, 8-hour averaging time, to be achieved by 2010. The achievement is based on the 4th highest measurement annually, averaged over 3 consecutive years. Federal authorities, however, set maximum acceptable limits of 82 ppb for a 1-hour maximum average, 25 ppb for a 24-hour maximum acceptable level, and 15 ppb for an annual mean (NBDELG, 2000). In 1999, there were 9 exceedences of the 1-hour National Ambient Air Quality objective for ozone of 82 ppb at the Hillcrest site (NBDELG, 2000).

Volatile Organic Compounds (VOCs)

VOCs all contain the element carbon and produce vapours readily at room temperature and normal atmospheric pressure. VOCs are emitted from fuels, solvents, paints, glues, etc. They are also emitted by a wide range of industrial sources, as well as by motor vehicles. A large number of VOCs can be emitted by industrial processes such as petrochemical or plastics industries (NBDELG, 2000).

The Provincial and Federal governments periodically monitor the air quality in the Study Area for this parameter.

5.3 Marine Environment

This subsection provides a biophysical description of the marine component of the Study Area, including general hydrology, aquatic, and biological environment.

5.3.1 Temperature and Salinity

Temperatures in the waters of the Bay of Fundy range from -1.7°C during winter months to seasonal highs of 16°C in late summer and autumn (NBDNRE, 1982). The vertical distribution of temperature and salinity in the Bay of Fundy is similar at half ebb and half flood tide, and appears to be controlled by the turbulent mixing resulting from strong currents and wave action. During the summer, surface water temperatures are coolest at the mouth of the Bay with a range of 9-11°C, and temperatures increase towards the head of the Bay (NBDNRE, 1982). In the winter, the reverse is true. The warmer waters are found at the mouth of the Bay (4°C) as a result of the warmer ocean water influencing the temperature. Temperatures range between 1-3°C over the remainder of the Bay. Salinity tends to range between 31-33 ppt in the Outer Bay, and does not appear to differ greatly with depth (NBDNRE, 1982). The area is ice-free year-round.

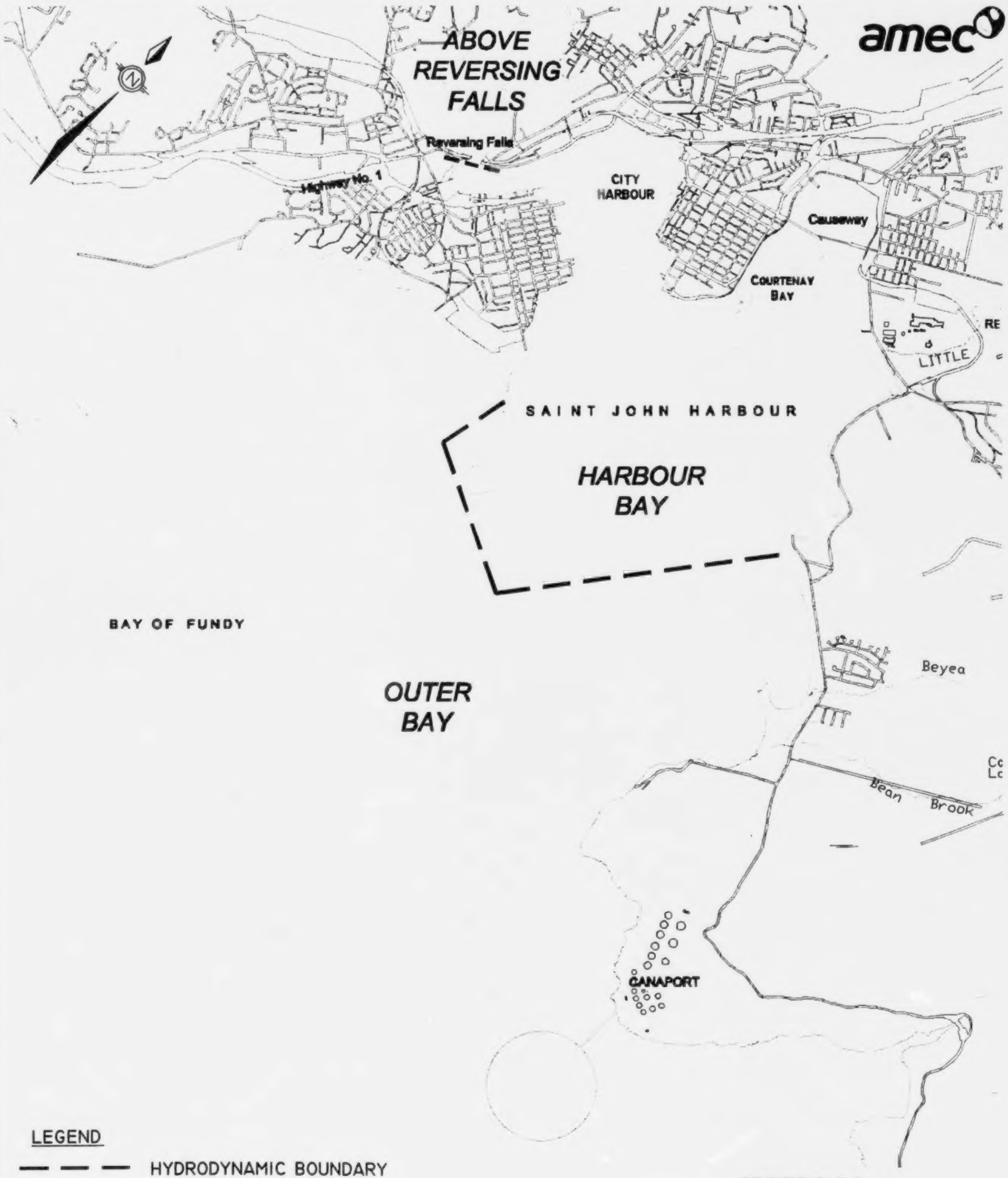
5.3.2 General Hydrology

Along the coast of New Brunswick, ebb currents are stronger than flood currents, resulting in net movement from Chignecto Bay towards Campobello and Grand Manan, out into the Gulf of Maine, and back into the Bay of Fundy along the coast of Nova Scotia (NBDNRE, 1982). The currents result from variations in the density of the water column, wind, tide, water movement caused by atmospheric pressure variations, storm surges, and freshwater inflow. The mean velocities at the mouth of the Bay of Fundy increase from 0.7 m/s to 1.3 m/s at its head. Extreme current measurements of 2-3 m/s have been recorded around the Fundy Isles (NBDNRE, 1982). The mean annual tidal variation in the Outer Bay is approximately 6 m.

The hydrodynamic nature of the Outer Bay functions in the formation of major habitat types found in the region. The strong currents flow through the various passages and ledges and scour the outer beaches and subtidal zones. The substrate within the general Study Area primarily consists of sand bottom, varying from coarse to fine grain size with rock and ledge outcrops (NBDNRE, 1982).

5.3.3 Hydrography

The major source of basic hydrodynamic information available for the Study Area is the Neu (1960) report. The interpretation of the data was state of the art at the time and is still considered invaluable. The Neu (1960) report results have been reinterpreted in the Saint John Harbour Environmental Quality Study report (WGA 1993) to describe what is known about exchange at the boundaries. The following information from the Saint John Harbour Environmental Quality Study Report (WGA, 1993) provides descriptions of the hydrodynamics in this marine environment.


N
ABOVE REVERSING FALLS
Reversing Falls
Highway No. 1
CITY HARBOUR
Causeway
COURTENAY BAY
RE
LITTLE
SAINT JOHN HARBOUR
HARBOUR BAY
BAY OF FUNDY
OUTER BAY
Beyea
Bean Brook
CANAPORT
LEGEND
HYDRODYNAMIC BOUNDARY
0
2000
METRES

TE21092/EIA - refurb project - sub areas (2002/04/02)

FIGURE 5.2
PROPOSED COLESON COVE
REFURBISHMENT PROJECT
HYDROGRAPHIC SUB-AREAS

The hydrodynamics of Saint John Harbour from its boundary with the Bay of Fundy to above the Study Area is characterized by three hydrographic sub-areas: Outer Bay, Harbour Bay (City Harbour and Courtenay Bay), and above Reversing Falls. Each sub-area, depicted in Figure 5.2, has a distinct physical environment.

5.3.3.1 Exchange with the Bay of Fundy

The mean tide and maximum tide ranges in the vicinity of Saint John are 6.5 m and 8.7 m, respectively. Over the Study Area, the mean tide has been determined by mass volume calculations to result in an overall tidal exchange rate of 77,000 cubic metres per second (CMS). The exchange is filled from both the Saint John River and the outer boundary. However, the maximum mean monthly flow of the Saint John River is 3271 CMS and is a small portion of the overall tidal exchange rate. The majority of the 77,000 CMS therefore crosses the boundary between the Bay of Fundy and the Outer Bay. The effect of the Saint John River is, however, detectable at the outer boundary. Lower density freshwater from the Saint John River lies on the surface of the water column and has a gradually greater influence on falling tide.

The velocity results across the boundary of the Outer Bay at different sets of tides show a complex boundary condition at any given tide with inflows along one part of the boundary and outflows along another part of the boundary. Most of the flow enters the Bay on rising tide along the western end of the boundary.

5.3.3.2 Circulation in the Outer Bay – Influence of the Saint John River

The two known dominant features of the circulation within the Outer Bay are the boundary tidal induced circulation and the stratified outflow of the Saint John River. The tidal induced circulation tends to produce a clockwise circulation on rising tide and a less intense counter-clockwise circulation on falling tide.

The tidal currents along the southwest boundary of the Outer Bay near Sheldon Point have tidal amplitudes of 40 to 60 CMS but mean values of only 5 to 10 CMS. The tidal currents in the deeper water (beyond 10 m mean low water depth) follow the typical pattern of a standing-wave tidal current, which are up-bay on rising tide and down-bay on falling tide, with slack water at high tide and low tide. The deeper water mean currents tend to be down-bay in response to the Saint John River inflow. Nearer to shore, the tidal currents deviate from this pattern and tend to become radial over time with strong onshore-offshore components.

The Saint John River acts as a flow superimposed on the tidal circulation. The less dense river flow is held back in the Harbour Bay on rising tide and extends outward in the Outer Bay on falling tide. The extent of the Saint John River plume in the Outer Bay is determined by the river flow and varies seasonally. The plume also spreads laterally due to density effects.

5.3.3.3 Exchange Between Outer Bay and Harbour Bay

The boundary between the Outer Bay and the Harbour Bay is shown in Figure 5.2. It is one of the more significant boundaries in the overall system. Overall tidal exchange across the Harbour Bay boundary is calculated to be approximately 3550 CMS and is almost the same as the mean monthly flows of the Saint John River in the spring. Filling of the overall exchange in the spring is therefore mostly due to the Saint John River, while in other months, more due to filling from the Outer Bay.

The baroclinic density exchange at the Harbour Bay boundary in most months has a bottom inflow and a surface outflow where the bottom inflow is two to four times the river flow and the surface outflow is three to five times the river flow. In the high river flow months of April and May, the flow in both layers is outward and equal to the river flow. During these months, there is little salt intrusion across the boundary. These could be considered as "normal" or "average" conditions. Significant storm events, however, may alter the relationships described.

5.3.3.4 Circulation and Flushing Within Harbour Bay

The Harbour Bay area incorporates the City Harbour, Courtenay Bay, and their channels. The baroclinic bottom flow entering the Harbour Bay boundary diminishes as it moves up the Harbour and the net flushing subsequently decreases towards the head of the Harbour. At the Reversing Falls, a portion of the higher salinity bottom water is carried over the Falls on rising and high tide to become bottom water in the Saint John Estuary. The Harbour Bay area has a volume of approximately 75 million m^3, resulting in a short flushing time for given flows.

The City Harbour is quite narrow and has large net non-tidal velocities for the two layered flow taking place within it. It is expected that conditions are varying from week to week depending on the Saint John River flow. Waterbodies are stratified in the City Harbour in the area above Navy Island, and salinities are higher along the northerly shore at the same depth. This could be due to the Coriolis acceleration of the surface outflow, but may also be due to more freshwater runoff from one shoreline than another.

There is limited freshwater inflow in Courtenay Bay channel. However, baroclinic inflow is estimated to be four or five times the freshwater inflow rate. The generating station on Courtenay Bay recirculates approximately 4.4 CMS at 10°C rise. Its pumping from deeper waters and its discharge of less dense water back to the surface will increase the baroclinic flow into Courtenay Bay at a long-term steady rate.

5.3.3.5 Circulation and Flushing Above Reversing Falls

The circulation in the area which extends from Reversing Falls about 6 km up the Saint John estuary and including South Bay is governed by the exchange across Reversing Falls. The Reversing Falls is both a ledge and narrow constricted channel. The channel constriction can result in a drop in water surface from the Harbour end of about 6 m at high tide. This constriction limits the amount of tidal flow upriver. During the spring, the Saint John River flow can be high enough that the flow does not reverse at Reversing Falls.

High density water from the Harbour flows into the basin above Reversing Falls and sinks to the bottom. It mixes with the river outflow on falling tide to return as brackish water to the Harbour. Stratification develops within the basin between Reversing Falls and the Kennebecasis Sill.

5.3.4 Marine Biological Environment

The Outer Bay is characterized by cool summer temperatures, warmer winter temperatures, high salinity, low loads of suspended sediment, and generally high water clarity (NBDNRE, 1982). The Outer Bay has a more oceanic dynamic, relative to the Inner Bay.

The unique oceanographic characteristics of the Bay of Fundy have resulted in a complex mosaic of plant and animal assemblages. The constant turmoil and changing tides provide some of the most productive water in Eastern North America, attracting a variety of marine mammals and birds. This section provides information on species commonly encountered in the Bay of Fundy.

5.3.4.1 Macrophytic Algae

Numerous species of marine plants occur intertidally and subtidally in the Bay of Fundy. The most abundant marine plants in the near shore environment are seaweeds. Red algae (*Rhodophyta*), green algae (*Chlorophyta*) and brown algae (*Phaeophyta*) occupy the littoral zone, attaching themselves to rocky or bouldery shores. Certain species of algae, including Irish moss (*Chondrus crispus*) and dulse (*Palmaria palmata*), have economic uses and are sometimes harvested by small craft using long rakes. Offshore algal populations are considered particularly diverse in southwest New Brunswick, possibly due to violent storms transporting species from southern waters.

As living plants, seaweeds provide food for some organisms and substrate for others. Dislodged plants become detritus as they are carried ashore with tides and storms, and this drives an entirely different system. Invertebrates which colonize or spend part of their life cycle on this decaying matter, feed multitudes of insectivores (Mackay *et al.,* 1979).

5.3.4.2 Littoral and Sub-littoral Invertebrates

It is likely that a great diversity of invertebrates take advantage of abundant decaying seaweed. Important species include the kelp fly (*Diptera sp.*), and the beach flea (*Platorchestia platensis*) which provide prey for both mammals and birds. In the intertidal zone may be found sponges, coelenterates, flat worms, ribbon worms, and annelids. Molluscs noted are chitons, snails (periwinkles), sea slugs (*nudibranchs*), mussels, and clams. Arthropods, decapods, and echinoderms of note include sea spiders, barnacles, hermit crabs, green crabs, and sea-urchins (Mackay *et al.,* 1979).

5.3.4.3 Commercially-Relevant Fish and Shellfish

A listing of fish and shellfish that are fished and/or landed commercially in the area is given in Section 5.5.

5.3.4.4 Seals

Four species of seals are seen in the Bay of Fundy. The harbour seal (*Phoca vitulina concolor*) is common, while the grey seal (*Halichoerus grypus*) is increasing in numbers. There is a thriving population of harbour seals in Saint John Harbour. Two sporadic visitors are the hooded seal (*Crystophora cristata*) and the harp seal (*Phoca groenlandica*) (Grand Manan Whale and Seabird Research Station, 2000). The four species of seals have varied diets but primarily feed on fish, crustaceans, and squid.

The harbour seal pups between May and June on unpopulated rocky ledges and offshore islands. The grey seal pups from mid-December to February in similar areas as the harbour seal. These remote locations for "haul out" and pupping are selected because of the species' wariness of humans (Grand Manan Whale and Seabird Research Station, 2000). The hooded and harp seals are not common in the Bay of Fundy, but they have been sighted on occasion.

5.3.4.5 Whales

Whales are also a common occurrence in the Bay of Fundy. Two types of whales frequent the coast of New Brunswick: odontocetes (*e.g.,* harbour porpoise) and mysticetes (*e.g.,* humpback whales) (Grand Manan Whale and Seabird Research Station, 2000).

Most of the whales are seasonal residents from late spring to early winter, however, some species have been seen in the winter months. Occasionally, other species venture into the Bay of Fundy such as belugas, orcas, pygmy sperm whales, sperm whales, white-beaked dolphins, bottle-nose dolphins, common dolphins, northern bottle-nose dolphins, beaked whales, and blue whales (Grand Manan Whale and Seabird Research Station, 2000). The typical habitat for these species occur elsewhere, and their presence would be rare.

The common odonocetes found in the Bay of Fundy are the harbour porpoise (*Phocoena phocoena*) and the Atlantic white-sided dolphin (*Lagenorhynchus acutus*).

The Atlantic white-sided dolphin actively seek moving vessels and is very active at the water surface. The reverse is true for the porpoise. As well, the Atlantic white-sided dolphin move offshore in the winter while the harbour porpoise remain in the Bay of Fundy and Gulf of Maine throughout the year (Grand Manan Whale and Seabird Research Station, 2000). Both species feed on fish, squid and some crustaceans, and breed during the summer months.

The Atlantic white-sided dolphin are not usually seen from shore whereas the harbour porpoise prefer bays, oceanic canals, and harbours. The main threat to the harbour porpoise is fishing gear.

The common mysticetes found in the Bay of Fundy include minke whale (*Balaenoptera acutorostrata*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and the right whale (*Eubalaena glacialis*) (Grand Manan Whale and Seabird Research Station, 2000). The sei whale (*Balaenoptera borealis*) is an occasional visitor to the Bay of Fundy.

Typically, the mysticetes follow the food source along the coast where the waters are turbulent and production is high. The fin whales tend to remain offshore in deep water, while the other common mysticetes prefer more shallow coastal water, taking advantage of the seasonal currents and ample food supply. The whales also typically spend the summer months in the Bay of Fundy's temperate waters and migrate to tropical and sub-tropical destinations during the winter months (Grand Manan Whale and Seabird Research Station, 2000).

5.3.4.6 Seabirds

The Bay of Fundy is one of the most important areas on the Canadian east coast for a wide variety of resident and migratory marine birds, shorebirds, and waterfowl. A very diverse seabird community exists along the Bay of Fundy, especially in southwestern New Brunswick.

The cooler summer temperatures in the Bay results in a situation where bird species, usually considered subarctic in distribution, nest regularly (NBDNRE, 1982). The reverse is true during the warmer winter months. Bird species typically found further south, winter along the islands and estuaries of the Bay.

The Bay of Fundy provides significant regional, national, and international breeding, migrating, and wintering habitat for a variety of water and shorebirds such as plovers, turnstones, sandpipers, yellowlegs, snipes, godwits, curlews, and phalaropes. The Fundy corridor hosts between 75-95% of the world's population of semipalmated sandpipers.

The primary threats to the shorebirds of the Bay of Fundy are blockages of the tidal rivers which alters the accumulation of sediment on the tidal flats making them less amenable to their food source (mudshrimp), potential for oil spills, and anthropogenic interference (*e.g.*, beach combers).

5.3.4.7 Species at Risk

The following sections focus on species at risk (*i.e.*, endangered, threatened, of special concern, and rare species), which are of concern due to potential disturbance as a result of Project development. Available information on the known occurrence of species at risk in the general Study Area was compiled and reviewed to determine their presence relative to the Project. Sources included the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2001), the Atlantic Canada Conservation Data Centre (AC CDC), published and unpublished species listings, and consultations with Provincial government agencies and researchers (*e.g.*, NBDNRE, Dalhousie University).

Floral (Plant) Species at Risk

Currently, there is no official designation for marine plant species at risk, as evidenced through various government contacts and research institutions (G. Saunders, S. Clayden, pers. comm., 2000).

Faunal (Animal) Species at Risk

Faunal species at risk in the general Study Area include those listed by COSEWIC as endangered, threatened, or "of special concern" (formerly vulnerable), those listed by the New Brunswick *Endangered Species Act*, and those identified through consultations with Provincial government agencies and researchers.

Mammal Species at Risk

Several marine mammals have been identified as threatened by COSEWIC. Most are deep sea inhabitants and will not be affected by the Project, however, COSEWIC (2001) designates the harbour porpoise as threatened nationally. Generally, the harbour porpoise inhabits coastal waters of less than 150 m deep. Harbour porpoise (*Phocoena phocoena*) populations have been decreasing due to incidental mortality associated with commercial fisheries. Porpoises probably enter Saint John Harbour to feed on anadromous fish such as gaspereau, shad, striped bass and salmon that are migrating into and out of the Saint John River system. As such, the harbour would represent important, but not critical rearing habitat for harbour porpoises.

COSEWIC (2001) designates the right whale (*Eubalaena glacialis*) as endangered. Right whales occur east of the outer islands of Grand Manan. Although not prime habitat, it is used on occasion (S. Gerriets, pers. comm., 2000).

The blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), and humpback whale (*Megaptera novaeangliae*) have been designated as species of special concern.

The general Study Area is not known to represent limiting or critical habitat for the above-mentioned species.

Bird Species at Risk

Bird species at risk are considered in the terrestrial environment section of this report (refer to Section 5.4.5.2).

Herpetile Species at Risk

There are approximately 25 species of amphibians and reptiles that are known to occur in New Brunswick (AMEC 2000). However, the cool climate along the Bay of Fundy shore excludes most of the species (NBDNRE, 1982).

COSEWIC (2001) designates the leatherback turtle (*Dermochelys coriacea*) as endangered. Leatherback turtles typically nest from November to April in specific tropical and subtropical waters. The remainder of the year, the turtles travel widely and are often found in temperate waters. The main threat to the leatherback turtle is poor nesting success resulting from anthropogenic interference.

Leatherback turtles are known to occur in the Bay of Fundy year round, however, the general Study Area is not known to represent limiting or critical habitat for the leatherback turtle (M. James, pers. comm., 2000).

Fish Species at Risk

COSEWIC (2001) lists the inner Bay of Fundy populations of the Atlantic Salmon (*Salmo salar*) as being endangered. The northern wolfish (*Anarhichas denticulatus*) and the spotted wolfish (*Anarhichas minor*) are listed by COSEWIC (2001) as threatened. The Atlantic cod (*Gadus* *morhua*) and the Atlantic wolfish (*Anarhichas lupus*) are listed as species of special concern in the Atlantic Ocean. Cod stocks have declined recently due to a number of reasons, including commercial fishing activities in the Atlantic Ocean.

5.4 Terrestrial Environment

Components of the terrestrial environment, including physiography, geology, hydrology, hydrogeology, wetland resources, vegetation, and wildlife are described in this section.

5.4.1 Physiography and Geology

The portion of the Study Area located west of the Saint John Harbour lies within the Musquash Lowland sub-division of the Saint Croix Highlands physiographic division. The terrain is undulating with regular gentle slopes of 4 to 9%. East of the Saint John Harbour, the Study Area lies within the Mispec Plateau sub-division of the Caledonian Highlands physiographic division. The terrain ranges from hummocky to rolling with regular slopes of 4 to 15%.

The following sections describe the geology and soils encountered within the Study Area.

5.4.1.1 Bedrock Geology

The Study Area west of the Saint John Harbour is located in the Saint Croix Highlands physiographic division, which is underlain by intensely deformed Ordovician, Silurian, and Lower Devonian sedimentary and volcanic rocks. These rocks have been intruded by granitoid rocks of Middle Devonian and early Carboniferous age making the bedrock geology in this region very complex.

The Study Area west of the Saint John Harbour is underlain by the Precambrian sedimentary rocks of the Ashburn and Martinon Formations of the Greenhead Group, and intrusive igneous rocks from the Fairville Granite, Ludgate Lake Granodiorite, and Spruce Lake Tonalite units. These rocks are overlain by the Cambrian and Ordovician sedimentary rocks of the Saint John Group and Cambrian intrusives of the Prince of Wales Granite and the Lorneville Volcanics, which are overlain in part by Carboniferous sedimentary rocks of the Lancaster and Balls Lake Formations.

The Study Area east of the Saint John Harbour is located in the Caledonian Highlands physiographic division, and is underlain by the Triassic terrestrial sedimentary rocks of the Quaco Formation of the Saint John Group and the Balls Lake Formation of the Mabou Group, and Precambrian volcanics. The Quaco Formation consists of red to grey conglomerate, sandstone and shale. The Balls Lake Formation consists of red to grey conglomerate and siltstone and includes silicic to mafic volcanic flows, tuff, and related intrusive rocks.

The bedrock in the Study Area typically consists of sedimentary and volcanic rocks. The upper portion of these rocks may be weathered and rippable, however, below the weathered portion, the bedrock in the Study Area is typically non-rippable.

5.4.1.2 Surficial Geology

The ground surface of the majority of the area is covered by glacial till deposits of varying thickness, texture, and stoniness. Glacial till can be described as poorly sorted to largely unsorted material with particle sizes ranging from clay to boulders.

The main till type encountered in the Study Area is lodgement till. Lodgement till typically has a loamy to sandy loam texture, reflecting the characteristics of the underlying bedrock. The thickness of the till ranges from blankets, generally 0.5 to 3 m thick to a discontinuous veneer over rock, less than 0.5 m thick. Clayey and silty tills are restricted to areas where poorly consolidated carboniferous shales are exposed. The till is mainly stony, with more than 35% of clasts pebble-sized and larger.

West of the Saint John Harbour, a portion of the Study Area is covered with marine sediments generally 0.5 to 3 m thick. These deposits typically consist of blankets and plains of sand, silt, some gravel and clay. There is also a portion west of the Harbour that is characterized by intertidal plains and salt marshes. This area consists of deposits of clay, silt, some fine sand, minor peat and organic sediment, generally greater than 2 m in thickness.

The overburden thickness within the Study Area varies greatly, even within a short distance. In some areas bedrock is shallow or at the ground surface.

5.4.1.3 Potential for Disturbance/Seismic Activity

Statistics indicate that of all the recent historical earthquakes that may have affected parts of the Study Area, very few have caused any significant damage. In addition, there has been no indisputable evidence that earthquakes in the Study Area have caused any surface displacement in recent geologic time. Therefore, it is possible that the earthquakes that may have occurred in modern times in the Study Area were caused by deeper geological activity rather than fault systems near the earth's surface. The potential for disturbance and seismic activity within the Study Area is low (L. Fyffe, pers. comm., 2002).

5.4.1.4 Potential for Acid Generating Bedrock

Acid generating rocks are a group of mineralized geologic materials that contain various sulphides. When these minerals are disturbed and come into contact with water, oxygen, and iron reducing bacteria, the sulphide minerals become oxidized and acid is generated in the process. The presence of iron reducing bacteria serves as a catalyst which accelerates acid production, and the potential for generation of acid rock drainage (ARD). Carbonate minerals, where present, serve to buffer acid generation.

The geologic formations encountered in the Study Area generally have a low to locally high potential of acid generating bedrock (M. McLeod, pers. comm., 2002).

5.4.1.5 Potential Areas of Subsidence (Karst Topography)

Sinkholes are unique geologic structures that result from surface water infiltration into, or groundwater flow through soluble geological formations, leading to the creation of cavities that may or may not be filled with water. These structures may also be simulated by underground mining activity.

The potential for karst topography in the Study Area is very low. There is Precambrian limestone and marble in this terrain, but they are quite unlikely soluble enough to result in sink holes. There are no records of sinkholes in the Study Area (C. Saint Peter, pers. comm., 2002).

5.4.1.6 Mineral Occurrences, Mining Claims, and Aggregate Resources

No economic mineral claims or mining leases are known to occur in the Study Area (R. Shaw, pers. comm., 2002). No aggregate resources are known to occur within the Study Area (M. O'Donnell, pers. comm., 2002).

5.4.1.7 Soils

Soils in the portion of the Study Area west of the Saint John Harbour are classed as podzolic, and those east of the Saint John Harbour are classed as humo ferric podzolic soils on sand parent material (Agriculture Canada, 1989).

The majority of the Study Area is covered by a glacial till of varying thickness, texture, and stoniness, which is occasionally overlain by a thin (<0.5 m) veneer of marine silt and sand. The overburden depth varies greatly, even over short distances, but is generally greater than 2 m in the western section and less than 0.5 m in the eastern portion of the Study Area (Rampton *et al.*, 1984).

The following sections provide a regional description of the soil landscape in the Study Area.

Soil Capability Classification for Agriculture

The Canada Land Inventory (CLI) Soil Capability Classification for agriculture (Canada Land Inventory, 2002) identifies mineral soils according to seven classes. Soils in Classes 1, 2 or 3 are considered capable of sustained production of common cultivated crops, whereas Class 4 soils are considered marginal for this use. Soils in Class 5 are capable of use only for permanent pasture and hay. Soils in Class 6 are capable of use for wild pasture only; a condition in which perennial forage crops can be maintained without improvement practices. Class 7 soils are considered incapable of use for arable agriculture or permanent pasture. A separate category has been established for organic soils (Class 0). While soils in the first four classes are capable of use for cultivated crops, they are also capable of use for perennial forage crops. Soils in all classes may be suited for forestry, wildlife and recreation.

The Study Area has no cultivated agricultural land (*i.e.*, pasture). Soil capability for agriculture within the Study Area is predominantly Class 7.

Soil Capability for Forestry

The CLI Soil Capability Classification for forestry is based on a national seven-class rating system (Canada Land Inventory, 2002). Land has been rated according to its capability to produce commercial timber in areas stocked with the optimum number and species of trees. This rating refers to the land in its natural state, without the use of improvements such as fertilizers and drainage. The best lands for tree growth are rated Class 1, whereas lands rated Class 7 will not yield timber in commercial quantities. These capability ratings represent the extremes of the classification system.

Soil capability for forestry within the Study Area ranges from Class 4 to Class 7, with moderate to severe limitations to the growth of commercial forests (Canada Land Inventory, 2002).

Erodible Soils

The susceptibility of soil to erosion is known as its "erodibility". Erodibility depends upon parameters such as soil texture, moisture content, void ratio, exchange ions, pH, and composition or ionic strength of the eroding water (Gray, 1996). Some soils are inherently more erodible (silts) than others (coarse well-graded gravels), and in general, increasing organic content and clay size fraction decreases erodibility. Typically, the erodibility of soils, rated in order of lowest to highest erodibility are; peat, course textured fluvial deposits, morainal deposits, lacustrine deposits, fluvial (silts and fine sands) deposits, and aeolian deposits (Brusnyk, 1985).

Water Erosion Risk mapping produced by Agriculture Canada (1992) indicates severe to high risk of erosion on bare soils in the Study Area. Protection from water erosion provided by usual crop management is excellent.

The Red Head area is known to have concerns of slope instability along the coast.

Contaminated Soils

There is a high potential for encountering contaminated soils in heavily industrialized areas. Some of the construction areas associated with the Project are located in heavily industrialized and disturbed areas.

5.4.2 Hydrology and Hydrogeology

The following sections describe the hydrological and hydrogeological conditions of the Study Area, including water quality for both surface and groundwater resources.

5.4.2.1 Surface Water Quantity

The dominant portion of the Study Area falls within the hydrometric subdivision 01AP as defined by Environment Canada (1989). All surface runoff from the subdivision drains into the Saint John River Estuary and Saint John Harbour.

The Study Area is partly urban, characterized by a high proportion of paved surfaces (roads, parking lots, etc.). Surface runoff generated from paved surfaces is collected quickly in the storm drain system, which directs the storm water to its discharge points. Urban surface runoff is characterized by high peaks and short duration.

The average annual precipitation in the General Study Area is approximately 1400 mm, of which approximately 280 mm is in the form of snowfall. The average annual runoff of the area is in the order of 850 mm. High seasonal flows are generally experienced in April and May as a result of snow melt and groundwater discharge. The stream flow typically decreases through the summer as a result of high evaporation and depleting groundwater storage. The stream flow typically increases in the fall due to lower temperature and reduced evaporation.

The Saint John River Estuary and the Saint John Harbour are dominantly the largest water bodies near the Study Area. The Saint John River drains an area of 55,000 km^2 above its discharge into the Saint John Harbour. Tidal range in the Saint John Harbour is in the order of 7.5 m, however, the range inside Reversing Falls never exceeds 0.7 m. At mean high tide, the water level in the harbour is 2 m higher than in the river.

The City of Saint John relies on four main surface water sources to meet its municipal and industrial water demands. These water sources include Loch Lomond Lake, Little River, Spruce Lake, and East Musquash River. The Spruce Lake watershed and Little River are located within the Study Area (J. Burtt, pers. comm., 2002).

Additional information related to the hydrology of the Study Area is discussed in the context of fish habitat and fishery resources in Section 5.5.

5.4.2.2 Surface Water Quality

The small streams that drain the City of Saint John in the Study Area are included in the Lower Saint John River Basin of New Brunswick. Surface water quality in this basin is dependent primarily on geology, watershed size, topography and vegetation. Surface waters are generally moderately soft and low-to-moderate in total dissolved solids (TDS) as the result of mineral contribution from the sandstone, shales and siltstones, which predominate within the basin. Colour and turbidity tend to be low, but fluctuate depending on the amount of run-off from this heavily populated area. The amounts of calcium and magnesium strongly influence the buffering capacity, pH, hardness and acidity of the water. General surface water chemistry data for the Lower Saint John River Basin are summarized in Table 5.1.

TABLE 5.1 Surface Water Resources: Water Quality Summary – Lower Saint John River Basin

Parameter	Mean Concentration* (mg/L)	Parameter	Mean Concentration* (mg/L)
Alkalinity (total)	17.0	Magnesium	1.3
Aluminum	0.016	Nickel (ext.)	0.014
Bicarbonate	18.1	Oxygen	10.4
Cadmium (ext.)	0.005	Potassium	0.6
Calcium	8.1	Sodium	4.3
Chloride	5.9	Sulphate	10.8
Copper (ext.)	0.020	Total Dissolved Solids	49.1
Iron (ext.)	4.02	Zinc (ext.)	0.073
Lead (ext.)	0.017		

Source: Environment Canada, 1989.
Note: *(84 surface water sites within the Lower Saint John River Basin).
ext = extractable

5.4.2.3 Groundwater Quantity

Groundwater resources developed for municipal water supply purposes may typically be extracted from a group of production wells and distributed to areas of a municipality. For such uses, the groundwater pumping rate is high and influences a relatively large area referred to as a capture zone.

Groundwater may be developed for other public or private uses, such as schools, hospitals, farms, industrial, and commercial establishments. Private wells for domestic uses are most common in rural areas. The groundwater pumping rate for domestic wells is small and, therefore, the area of the capture zone is also small in comparison to high capacity wells.

NBDELG has identified groundwater protection areas for a number of municipalities, and is also in the process of identifying groundwater protection areas for other municipalities using groundwater as their water supply source. Certain developments within the capture zones of the municipal wells may affect the public water supply, both in terms of quantity and quality. Thus, developments within a groundwater protection area require approval from NBDELG and affected municipalities.

The City of Saint John relies primarily on surface water to meet its water demand. However, there are two production wells located within the Study Area; one located at 103 Ocean Drive (PID# 00416610) and the other at 14 Seward Crescent (PID# 55029479). NBDELG has yet to complete a wellfield protection study in Saint John, however it is recommended that a 500 m (Zone B) diameter circle around each well be set as a buffer and that the Wellfield Protected Area Designation Order – *Clean Water Act* guidelines be followed for activities permitted within that zone (M. Paul-Elias, pers. comm., 2002).

Springs occur when the groundwater table intersects the ground surface, and are likely to occur on hillsides or valley floors. Those valleys in which the flanks are covered with glaciofluvial sediments are most likely to provide sustained groundwater flow to watercourses during drought periods. There are no springs known to occur within the Study Area.

5.4.2.4 Groundwater Quality

Groundwater quality in New Brunswick for domestic consumption is generally good with the exception of isolated aquifers that have naturally occurring and/or anthropogenic water quality problems. Groundwater quality data available for southern New Brunswick are presented in Table 5.2.

Typical naturally occurring water quality problems include anomalous iron and manganese concentrations, bacteria, salt, sulphate, and hardness (calcium/magnesium). Localized areas also experience elevated concentrations of arsenic and uranium. Anthropogenic inputs include nitrate and bacteria from septic fields, fertilizers from agricultural runoff, salt from road de-icing operations, petroleum, oil, lubricant (POL) from fuel storage tanks, and landfill leachate.

The quality of groundwater in surficial deposits (*e.g.*, glaciofluvial) in New Brunswick is generally considered to be good to excellent. Locally, iron, manganese and colour present problems. Surficial aquifers are more susceptible to anthropogenic contamination as a confining layer generally is absent or limited in vertical extent.

In terms of bedrock aquifers, water of acceptable quality is generally available from aquifers located in Triassic, Pennsylvanian and Mississippian rocks (*e.g.*, siltstones, sandstones sequences). Locally, iron, manganese and hardness present aesthetic concerns.

TABLE 5.2 Summary of Selected Groundwater Quality Parameters for Southeastern New Brunswick

Parameter	Mean Concentration (mg/L)	Parameter	Mean Concentration (mg/L)
Alkalinity	127.259	Magnesium	3.802
Aluminum	0.034	Manganese	0.139
Arsenic	0.001	Nickel	0.018
Barium	0.277	Total Nitrogen	0.747
Boron	0.095	PH	Generally 7.0 to 8.5
Cadmium	Below detection limit	Potassium	1.401
Calcium	33.417	Sodium	62.460
Chloride	64.563	Sulphate	18.092
Copper	0.102	Total Hardness (equivalent of $CaCO_3$)	100/840
Flourine	0.627	Total Dissolved Solids	322.167
Iron	0.236	Zinc	0.0945
Lead	0.001		

Source: Boyle *et al.*, 1994.

5.4.3 Wetland Resources

Wetlands may be defined as "...lands transitional between terrestrial and aquatic systems where the water table is at, or near, the surface or the land is covered by shallow water at some time during the growing season. Wetlands are characterized by poorly drained soils and predominantly hydrophytic, or water tolerant vegetation" (NBDNRE, 2001a).

Both collectively and as individual units, wetland resources serve a variety of important ecological functions. Wetlands function in the maintenance of surface and groundwater quantity and quality, as well as providing fish and wildlife habitat. The value of wetlands to society and their ecological value are derived from their biological productivity and biodiversity.

The Federal government has established a "no net loss of wetland function" policy in co-operation with the Provinces (Environment Canada, 1991). Pursuant to this policy, wetlands in New Brunswick have been given specific protection under the *Clean Environment Act* and the *Clean Water Act*. The New Brunswick *Environmental Impact Assessment Regulation*, requires registration of "all enterprises, activities, projects, structures, works on programs affecting two hectares or more of bog, marsh, swamp or other wetland". NBDELG also requires a watercourse alteration permit for any disturbance of the ground within 30 m of the bank of a watercourse, and wetlands are interpreted as watercourses under the definition outlined in the Watercourse Alteration Technical Guidelines (H. Pelkey, pers. comm., 2000).

5.4.3.1 Wetland Identification

Wetlands were identified within the Study Area based on the New Brunswick Wetland Atlas (Environment Canada, 1987) and the New Brunswick Forest Inventory maps. Two major wetlands, the Red Head Marsh, and the Saints Rest Marsh, have been identified in the Study Area.

5.4.3.2 Wetland Management Initiatives

Ducks Unlimited (DU) has been involved in creating and enhancing wetland habitat for wildlife in the Maritimes since the 1960s. A DU impoundment is located within the Red Head Marsh (139 acres). There is also a DU project at the Refinery Marsh, located on the Irving Refinery property (J. Harvey, pers. comm., 2002).

Other specifically designated habitats that correspond with wetland areas include Eastern Habitat Joint Venture (EHJV) wetlands. EHJV wetlands are secured through partnerships between private, corporate, and government organizations that contribute to the implementation of the North American Waterfowl Management Plan. EHJV wetland habitats include those that are considered critical for breeding, staging and wintering for waterfowl. There are no EHJV wetlands located within the Study Area (T. Byers, pers. comm., 2002).

5.4.4 Vegetation (Flora)

The Saint John region is identified by Rowe (1972) as being within the Fundy Coast Forest Region, characterized by patchy forest on the shore of the Bay of Fundy composed of white spruce, black spruce, balsam fir, and tamarack. Also present are large raised sphagnum bogs. Further inland, balsam fir and red spruce predominate, while at higher elevations white and yellow birch, beech, and sugar maple occur infrequently.

5.4.4.1 Forested Land

New Brunswick maintains an inventory of old spruce/fir habitat (OSFH) on Crown Land. OSFH stands are defined as those stands with the structural and spatial attributes which meet the requirements of old forest-dependant species, such as pine marten, which require large areas of habitat (NBDNRE, 2000). Such areas are typically moderately moist, with mature or over-mature stands of conifers or conifer-dominated mixed woods, with a high degree of crown closure and a high incidence of snags (standing dead wood) and windfalls (NBDNRE, 2000). Forest harvesting and forest road construction are both permitted within OSFH stands. NBDNRE maintains OSFH amounts and stand conditions on a provincial basis, such that OSFH slated for protection (*i.e.*, restriction on cutting) may change from year to year. OSFH in New Brunswick are not fixed locations and pertain only to specific softwood areas on Crown Land. There are no OSFH areas identified within the Study Area.

NBDNRE maintains permanent forest sample plots (PSPs) throughout New Brunswick. These plots have high educational and research value and contribute to enhancement of forest management practices in the province. There are no PSPs located within the Project Study Area (NBDNRE, 2001).

5.4.4.2 Plant Species at Risk

Plant species at risk include those listed by COSEWIC as endangered, threatened or "of special concern", those protected under the New Brunswick *Endangered Species Act*, and those designated as rare in New Brunswick (Hinds, 2000). Table 5.3 summarizes plant species identified in the above sources. None of the plant species in Table 5.3 are known to occur in the Study Area.

TABLE 5.3 Plant Species at Risk in New Brunswick

COSEWIC (Nov. 2001)	New Brunswick *Endangered Species Act*	Species Experts/Literature
ENDANGERED:	ENDANGERED:	RARE:
Furbish's Lousewort *(Pedicularis furbishiae)*	Anticosti Aster *(Aster anticostensis)*	Furbish's Lousewort *(Pedicularis Furbishiae)*
THREATENED:	Bathurst Aster *(Aster subulatus var.obtusifolius)*	Gentian ssp. *(Gentiana rubricaulis)*
Anticosti Aster *(Aster anticostensis)*	Furbish's Lousewort *(Pedicularis furbishiae)*	Aster ssp. *(Aster borealis)*
SPECIAL CONCERN:	Gulf of Saint Lawrence aster *(Aster laurentianus)*	Bladderwort ssp. *(Utricularia Geminiscapa)*
Bathurst aster *(Aster subulatus var.obtusifolius)*	Parker's Pipewort *(Eriocaulon parkeri)*	Screwstem *(Bartonia peniculata ssp. Iodandra*)
Gulf of Saint Lawrence aster *(Aster Laurentianus*)	Pine-drops *(Pterospora andromedea)*	
	Prototype Quillwort *(Isoetes prototypus)*	
	Southern Twayblade *(Listera australis)*	

Also, data on species at risk (species with Nature Conservancy ranks of S1, S2, or S3) known to occur within the Study Area were reviewed against AC CDC data. Plant species identified are listed in Table 5.4.

TABLE 5.4 Plant Species at Risk Known to Occur in the Study Area as Identified by AC CDC (2002)

Scientific Name:	Common Name:
S1 (1-5 occurrences in NB)*	
Antennaria howellii ssp. Petaloidea	Pussy-Toes
Ranunculus sceleratus	Cursed Crowfoot
Saxifraga paniculata	White Mountain Saxifrage
S2 (6-20 occurrences in NB)*	
Arabis drummondii	Drummond Rockcress
Arabis hirsute	Western Hairy Rock-Cress
Carex magellanica ssp. Magellanica	Bog Sedge
Carex salina	Salt-Marsh Sedge
Chenopodium rubrum	Coast-Blite Goosefoot
Cypripedium parviflorum	Small Yellow Lady's-Slipper
Cypripedium reginae	Showy Lady's-Slipper
Eriophorum chamissonis	Russet Cotton-Grass
Gentianella amarella ssp. Acuta	Northern Gentian
Hedeoma pulegioides	American Pennyroyal
Listera auriculata	Auricled Twayblade
Myriophyllum farwellii	Farwell's Water-Milfoil
Ophioglossum pusillum	Adder's Tongue
Polygala senega	Seneca Snakeroot
Rosa palustris	Swamp Rose
Stellaria humifusa	Creeping Sandwort
S3 (21-100 occurrences in NB)*	
Arethusa bulbosa	Swamp-Pink
Asplenium trichomanes-ramosum	Green Spleenwort
Botrychium dissectum	Cutleaf Grape-Fern
Botrychium lanceolatum var. angustisegmen	Lance-Leaf Grape-Fern
Calopogon tuberosus	Tuberous Grass-Pink
Clematis occidentalis	Purple Clematis
Corallorhiza maculata	Spotted Coralroot
Cystopteris fragilis	Fragile Fern
Geocaulon lividum	Northern Comandra
Liparis loeselii	Loesel's Twayblade
Primula mistassinica	Bird's-Eye Primrose
Xyris Montana	Northern Yellow-Eyed-Grass

Note: * - occurrence refers to locations.

Table 5.4 was reviewed for plant species location and habitat characteristics. Much of the Study Area is highly disturbed urban or industrial land, where the likelihood of plant species at risk to occur is very low. However, it is possible that the plant species identified or other plant species at risk may occur in relatively undisturbed locations within the Study Area, including watercourses/riparian zones, wetlands, steep slopes, and coastal areas.

5.4.5 Wildlife (Fauna)

The following sections focus on species at risk (*i.e.*, endangered, threatened, "of special concern", and rare species) that are of concern due to potential disturbance as a result of Project development. Available information on the known occurrence of faunal species at risk in the Study Area was compiled and reviewed to determine their presence relative to the Project. Sources included COSEWIC (2001), the New Brunswick *Endangered Species Act*, the AC CDC database, published and unpublished species listings, and consultations with government agencies and researchers. Table 5.5 summarizes faunal species at risk for New Brunswick.

5.4.5.1 Mammals

There are 57 known species of mammals native to New Brunswick (Dilworth, 1984). Due to the habitat conditions within the Study Area, it is reasonable to expect that mammals inhabiting the vicinity of the Project could include insectivores (*e.g.*, bats) and omnivores (*e.g.*, skunk). There is also the potential for some uncommon shrews (water and artic) to occur within the Study Area (D. McAlpine, pers. comm., 2002).

Mammal Species at Risk

Under the New Brunswick *Endangered Species Act*, two species of mammals are protected as endangered and regionally endangered, respectively, in the province:

- the eastern cougar (*Felis concolor cougar*); and
- the Canada lynx (*Lynx canadensis*).

The occurrence of these species has not been confirmed in the Study Area. In fact, the cougar was not confirmed as being present in New Brunswick until 1992, near Juniper (Cumberland and Dempsey, 1994). However, it is not known if this was an eastern cougar. The habitat requirements of the eastern cougar are not known. However, elsewhere throughout its range, cougars have been found in a variety of habitats ranging from large swampy areas to dense coniferous stands. The major prey species for cougar in these areas is white-tail deer. There are no records of cougar sightings within the Study Area (C. Libby, pers. comm., 2002).

In New Brunswick, lynx are reported to mostly inhabit the northern portion of the Saint John River basin (Choates, 1973). Lynx tend to inhabit wooded and swampy areas where snowshoe hare are abundant for food (Peterson, 1966). Due to the small size, isolation, and degraded condition of vegetated portions of the Study Area, it is very unlikely that either species occurs there. There are no records of lynx sightings within the Study Area (C. Libby, pers. comm., 2002).

COSEWIC (2001) designates two mammals as species of special concern which occur in New Brunswick. Gaspé shrew (*Sorex gaspensis*) and southern flying squirrel (*Glaucomys volans*). The Gaspé shrew has previously been reported to inhabit an extremely restricted range in northern New Brunswick (near Mount Carleton and Moose Mountain)(Environment Canada, 2001). While suspected to inhabit New Brunswick, the southern flying squirrel has yet to be reported in the province (D. McAlpine, pers. comm., 2001). Thus, neither species is likely to inhabit the Study Area.

TABLE 5.5 Faunal Species at Risk in New Brunswick[1]

Committee on the Status of Endangered Wildlife in Canada (COSEWIC, Nov. 2001)	NB Endangered Species Act	Species Experts/Literature
ENDANGERED: Birds: Eskimo Curlew *(Numenius borealis)* Piping Plover *(Charadrius melodus)* Roseate Tern (*Sterna dougallii*) Lepidoptera: Maritime Ringlet Butterfly *(Coenonympha tullia nipisiquit)*	ENDANGERED: Mammals: Eastern Cougar *(Felis concolor cougar)* Birds: Harlequin Duck Peregrine Falcon Piping Plover Lepidoptera: Maritime Ringlet Butterfly Herpetiles: Leatherback Turtle *(Dermochelys coriacea)*	RARE: Mammals: Water Shrew *(Sorex palustris)* Smoky Shrew *(Sorex fumeus)* Big Brown Bat *(Eptesics fuscus)* Long-tailed Shrew *(Sorex dispar)* Little Brown Bat *(Myotis lucifugus)* Long Eared Bat *(Myotis septentrionalis)* Eastern Pipistrelle *(Pipistrellus subflavus)* Lepidoptera: Maritime Ringlet Butterfly Herpetiles: Four-toed Salamander (*Hemidactylium scutatum*) Gray Treefrog (*Hyla versicolor*)
THREATENED: Birds: Peregrine Falcon *(Falco peregrinus anatum)* Least Bittern *(Ixobrychus exilis)*	REGIONALLY ENDANGERED: Mammals: Canada Lynx *(Lynx canadensis)* Birds: Bald Eagle *(Haliaeetus leucocephalus)*	SENSITIVE TO HABITAT DISTURBANCE: Birds: Merlin (*Falco columbarius*) The Great Crested Flycatcher (*Myiarchus crinitus*) Northern Saw-Whet Owl (*Aegolius acadicus*) Northern Mockingbird (*Mimus polyglottos*) Virginia Rail (*Rallus limicola*) Cooper's Hawk (*Accipiter copperii*) Eastern Bluebird (*Sialia sialis*)
SPECIAL CONCERN: Mammals: Gaspé Shrew *(Sorex gaspensis)* Southern Flying Squirrel *(Glaucomys volans)* Birds: Harlequin Duck (*Histrionicus histrionicus*) Barrow's Goldeneye (*Bucephala islandica*) Ivory Gull *(Pagophila eburnea)* Short-eared Owl *(Asio flammeus)* Bicknell's thrush (*Catharus bicknelli*) Yellow Rail (*Cotumicops noveboracensis)* Lepidoptera: Monarch Butterfly *(Danaus plexippus)* Herpetiles: Wood Turtle *(Clemmys insculpta)*		

Note: 1. Excludes marine species where applicable (not relevant to terrestrial environment description).

Dilworth (1984) identified several mammalian species as rare within New Brunswick, including one bat species (big brown bat (*Eptesics fuscus*)), and two species of shrew (water shrew (*Sorex palustris*) and smokey shrew (*Sorex fumeus*)). These shrew species typically inhabit damp areas, or areas close to water. The big brown bat inhabits urban forested areas. There are three records confirming the presence of the big brown bat in the Study Area (S. Gerriets, pers. comm., 2002). None of the other species have been confirmed to occur in the Study Area.

Other than those species previously listed, Clayden, *et al.*, (1984) identified the long-tailed shrew (*Sorex dispar*), two species of bat (little brown bat (*Myotis lucifugus* (LeConte) and eastern long-eared bat (*Myotis septentrionalis* (Merriam))), and the eastern pipistrelle (*Pipistrellus subflavus*), as being vulnerable to disturbance. The shrew species is known only from southeast New Brunswick, outside the Study Area. The bat and pipistrelle species are typically forest inhabitants. The little brown bat has been reported to inhabit caves in the Saint John area (N. Craig, pers. comm., 1997). The presence of the eastern long-eared bat and the eastern pipistrelle have been confirmed in the Greenhead Cave located within the Study Area (pers. comm., Nature Trust of New Brunswick, 2002). None of the other species have been confirmed to occur in the Study Area.

The AC CDC identified the following three mammalian species of concern known to occur within or near the Study Area:

- Big brown bat (*Eptesicus fuscus*);
- Eastern red bat (*Lasiurus borealis*); and
- Hoary bat (*Lasiurus cinereus*).

5.4.5.2 Birds

Approximately 350 resident and migratory bird species have been reported in New Brunswick (Squires, 1976). Avian species diversity in temperate regions is, in part, a function of foliage height diversity (*i.e.,* the greater the height diversity, the greater the number of species using that habitat) (MacArthur and MacArthur, 1961). This is particularly true in deciduous forest stands. Species diversity is also related to floral species diversity (Morrison, 1991). Thus, grasslands would support limited species diversity, while a successional deciduous forest may support relatively higher species diversity.

Bird mortality is reported to be greatest during the first year of life. Therefore, breeding and fledgling populations are considered to be the avian life stages most sensitive to potential disturbance.

The Saint John Harbour is not a significant wintering area for seabirds (JWEL, 1994). Other migrating species such as Black Duck (*Anas rubripes*), Common Merganser (*Mergus merganser*), Common Goldeneye (*Bucephala clangula*), Gulls (*Laridae sp.*), Cormorants (*Phalacrocorax sp.*), Scoter (*Melanitta sp.*), and Common Eiders (*Somateria mollissima*) are known to occur in the Saint John area and are protected under the *Migratory Birds Convention Act* (JWEL, 1994; R. Gautreau, pers. comm., 2001).

The nearest known seabird nesting site to the Project activities is located on Manawagonish Island (JWEL, 1994).

Bird Species at Risk

The New Brunswick *Endangered Species Act* designates the harlequin duck (*Histrionicus histrionicus*), peregrine falcon (*Falco peregrinus anatum*) and the piping plover (*Charadrius melodus)* as endangered in New Brunswick, and the bald eagle (*Haliaeetus leucocephalus*) is listed as regionally endangered.

Harlequin ducks typically nest on rapid, rocky rivers. In the Maritimes, this species has only been reported to breed in northern New Brunswick. However, the harlequin duck is known to overwinter near Grand Manan Island, and along the coast near Point Lepreau. Harlequin ducks are known to winter near Anthony's Cove, on the western edge of the Study Area (J. Hoyt, pers. comm., 2002).

Peregrine falcon (*Falco peregrinus anatum*) is listed by COSEWIC as threatened. (COSEWIC, 2001). Peregrine falcons nest on cliff faces and similar high sites inaccessible to predators. Within the Study Area, one pair of falcon has been reported to nest near the northeast end of the Harbour Bridge over Saint John Harbour. There is also a possible nest site located on the southwest point of Taylors Island. If the project work involves work adjacent to either one of these sites, the presence or absence of the bird would have to be confirmed (J. Hoyt, pers. comm., 2002).

Eagles tend to nest in large trees near water, and feed on fish and carrion (Erskine, 1992). There is record of a pair of bald eagle nests on Musquash Island (S. Gerriets, pers. comm., 2002).

The short-eared owl (*Asio flammeus*) is listed as a species of special concern by COSEWIC (COSEWIC, 2001). The short-eared owl is known to breed in wet meadows and marshes, and coastal bogs and grasslands. Their abundance in the region may be limited to the abundance of their main prey species, the meadow vole. The presence of the short-eared owl has not been confirmed within the Study Area.

COSEWIC lists the piping plover (*Charadrius melodus*), Eskimo curlew (*Numenius borealis*) and the roseate tern (*Sterna dougallii*) as endangered (COSEWIC, 2001).

Piping plover are unlikely to be found in the Study Area as they nest and rear their young on open sandy coastal shorelines. The Eskimo curlew has not been seen in New Brunswick in over 100 years, and historically has bred only in the Northwest Territories (Environment Canada, 2001). Therefore, the Eskimo curlew is not likely to occur in the Study Area. Roseate tern are unlikely to be found in the Study Area as they nest and rear their young on offshore islands and islets.

The least bittern, nationally listed as threatened (COSEWIC, 2001), inhabits grassy fresh water wetlands and has been confirmed breeding in the Red Head Marsh Ducks Unlimited impoundment (J. Hoyt, pers. comm., 2002).

Due to their more specific habitat requirements (Erskine, 1992), local populations of the following may be considered sensitive to habitat disturbance (Clayden *et al.*, 1984):

- Virginia rail (*Rallus limicola*);
- Merlin (*Falco columbarius*);
- Great crested flycatcher (*Myiarchus crinitus*); and
- Northern mockingbird (*Mimus polyglottos*).

The Virginia rail nests in freshwater wetlands and is known to occur in the Study Area. The remaining sensitive species listed above nest in forest and edge habitat. The northern mocking bird is also reported to be present within the Study Area. The merlin and the great crested flycatcher have not been confirmed in the Study Area.

The AC CDC identified the following 22 bird species of concern known to occur within or near the Study Area:

- Least bittern (*Ixobyrchus exillus*);
- Green heron (*Butorides virescens*);
- American widgeon (*Anas americana*);
- Red-breasted merganser (*Mergus serator*);
- Whip-poor-will (*Caprimulgus vociferus*);
- Willow flycatcher (*Empidonax traillii*);
- Marsh wren (*Cistothorus palustir*);
- Northern mockingbird (*Mimus polyglottus*);
- Black-crowned night heron (*Nycticorax nycticorax*);
- Virginia rail (*Rallus limicola*);
- Common moorhen (*Gallinula chloropus*);
- Canada goose (*Branta canadensis*);
- Gadwell (*Anas strepera*);
- Buffelhead (*Bucephala albeola*);
- Wilson's phalarope (*Phalaropus tricolor*);
- Common Tern (*Sterna hirundo*);
- Northern rough-winged swallow (*Stelgidopteryx serripennis*);
- House Wren (*Troglodytes aedon*);
- Nelson's sharp-tailed sparrow (*Ammodramus nelsoni*);
- Northern Cardinal (*Cardinalis cardinalis*);
- Red crossbill (*Loxia curvirostra*); and
- White-winged crossbill (*Loxia leucoptera*).

5.4.5.3 Herpetiles

There are approximately 25 species of amphibians and reptiles (*i.e.*, herpetiles), that inhabit New Brunswick, including various species of salamanders, frogs, turtles, and snakes (Gorham, 1970). It is likely that a variety of these species inhabit watercourses in the Study Area.

Herpetile Species at Risk

The wood turtle (*Clemmys insculpta*) has been designated by COSEWIC (2001) and the AC CDC as a species of special concern. The species is long lived (~40 years) and slow to mature (17-20 years), resulting in vulnerability of the species. Wood turtles construct their nests near water, in open sandy areas, such as high riverbanks, roadsides, rail embankments, and wetlands. Nesting usually occurs in late June or July with emergence in September or October. They hibernate half buried in the substrate of fast flowing watercourses (T. Herman, pers. comm., 1997).

There are three records of wood turtle occurrence in the Study Area (S. Gerriets, pers. comm., 2002).

5.4.5.4 Invertebrates

Invertebrates are typically the most diverse group of fauna present in a given ecosystem (*i.e.*, species diversity), and represent a key component of the food web.

Only one invertebrate species, the Maritime ringlet butterfly (*Coenonympha inornata nipisiguit*), is designated as endangered by the New Brunswick *Endangered Species Act* and COSEWIC (2001). This invertebrate species is endemic to salt marsh areas and in New Brunswick is known only from the Peter's River Marsh, Daly's Point Marsh and the Karen Point Marsh in Bathurst, New Brunswick (Clayden, *et al.*, 1984; Webster, 1994). This species is not likely to occur in the Study Area.

The monarch butterfly (*Danaus plexippus*) is designated as a species of special by COSEWIC (COSEWIC, 2001). The monarch butterfly overwinters in coastal Monterey pine, Monterey cypress, eucalyptus groves in California and fir forests in Mexican mountains. These overwintering sites face threatening development, however, Mexican and international efforts are in place to protect the monarch butterflies in Mexico. In New Brunswick, monarch butterflies utilize habitats such as meadows, weedy fields and watercourses where milkweed is present, during their breeding season. There is one recorded occurrence of the monarch butterfly in the Study Area (S. Gerriets, pers. comm., 2002).

The AC CDC identified the following 11 invertebrate species of concern known to occur within or near the Study Area:

- Monarch butterfly (*Danaus plexippus*);
- Least skipper (*Ancyloxypha numitor*);
- American Copper (*Lycaena phlaeas americana*);
- Compton tortoiseshell (*Nymphalis vaualbum j-album*);
- Salt marsh copper (*Lycaena dospassosi*);

- Crowberry blue (*Lycaeides idas empetri*);
- Silvery checkerspot (*Chlosyne nycteis*);
- Jutta arctic (*Oeneis jutta ascerta*);
- Orange Sulphur (*Colias eurytheme*);
- Summer Azure (*Celastrina neglecta*); and
- Question mark (*Polygonia interrogationis*).

5.5 Fish Habitat and Fishery Resources

This section provides a compilation and review of existing background information and data to enable assessment of potential impacts of the Project on fish, fish habitat and other aquatic resources.

The marine water column in the Study Area is always stratified, with lighter fresh water on the surface overlying denser salt water underneath. This means that the composition of the fish community depends on the salinity level that is being considered.

The following marine species could occupy the saline water in the Study Area (Washburn & Gillis, 1993; Dadswell *et al.*, 1984):

- Cod (*Gadus morhua*)
- Silversides (*Labidesthes* sp.)
- smooth flounder (*Pleuronectes putnami*)
- sculpin spp (*Cottus* sp.)
- sea raven (*Hemitripterus americanus*)
- Atlantic seasnail (*Neoliparis atlanticus*)
- Haddock (*Melanogrammus aeglefinus*)
- white hake (*Urophycis tenuis*))
- mummichog (*Fundulus heteroclitus*)
- halibut (*Hippoglossus hippoglossus*)
- plaice (*Hippoglossoides platessoides*)
- silver hake (*Merluccius bilinearis*)
- menhaden (*Brevoortia tyrannus*))
- Windowpane (*Scophthalamus aguosus*)
- Butterfish (*Peprilus triacanthus*)
- ocean pout (*Zoarces americanus*)
- grubby (*Myoxocephalus aenaeus*)
- rock gunnell (*Pholis gunnellus*)
- Lumpfish (*Cyclopterus lumpus*)
- Bluefish *(Pomatomus saltator*)
- wolfish (*Anarhichas* sp.)
- shark spp (*Squaliformes* spp.)
- mackerel (*Scomber scrombrus*)
- winter flounder *(Pseudopleuronectes americanus*)
- sole (*Soleidae spp.*)

The majority of these fish species would only occasionally be present in the Study Area. The Study Area would not provide critical habitat for any of these species.

The following estuarine or anadromous species could also be present within the Study Area (Washburn & Gillis, 1993):

- shad (*Alosa sapidissima*)
- alewife (*Alosa pseudoharengus*)
- Tomcod (*Michragadus tomcod*)
- blueback *herring (Alosa aestivalis*)
- eel (*Anguilla rostrata*)
- stickleback *spp.* (*Gasterosteidae*)
- shortnose sturgeon (*Acipenser brevirostrum*)
- Atlantic sturgeon (*Acipenser oxyrhynchus*)
- Herring (*Alosa* sp.)
- smelt (*Osmerus* spp)
- Atlantic salmon (*Salmo salar*)
- striped bass (*Morone saxatilus*)

These are the most ecologically and socio-economically important species that exist in the Study Area. Many spawn in the Saint John River system and have nursery and rearing habitat there. The Study Area is, therefore, an important migration channel to provide access to the upper reaches of the Saint John River.

The following shellfish species may also be present in the bottom water within the Study Area (Washburn & Gillis, 1993):

- lobster (*Homarus americanus*);
- scallop (*Placapecten magellanicus*);
- periwinkle (*Littorina littorea*)
- crab (*Chionoecetes opillio*)
- squid (*Loligo sp.*)

These are marine species that would probably be present to a larger extent in a higher saline environment outside of the Harbour.

5.5.1 Fish Species at Risk

The following fish species are identified by the ACCDC as being present in the Study Area:

- Shortnose sturgeon (*Acipenser brevirostrum*);
- Atlantic sturgeon (*Acipenser oxyrhynchus*);
- Atlantic salmon (*Salmo salar*); and
- Striped bass (*Morone saxatilus*).

The Study Area is centred on the Saint John River, and all of the salmon stocks that spawn and use this river for nursery habitat are in the North American assemblage. North American stocks forage on the high seas off Greenland and the Labrador Sea (Mills, 1993). Immediately to the east of the Study Area, there are approximately 35 rivers that support the unique inner Fundy stocks. These fish all spawn after one winter at sea, and there is a high degree of repeat spawning in the populations. It is thought that these fish do not migrate to the high seas to forage, and instead forage and over-winter in the Bay of Fundy and the Gulf of Maine (Amiro, 1998).

Both the Saint John River stocks and those of the inner Bay of Fundy are well below their historic population levels. Returns to the upper Saint John River in 2001 totaled only 2,871 salmon and grilse (DFO, 2001), a 90% decline from the early 1980s (WGA, 1999). It is thought that adverse conditions on the high seas have resulted in abnormally high mortality of these fish. In response to this decline, all fisheries for Saint John River salmon (aboriginal, sport fisheries and commercial fisheries) have been closed since the mid-1990s. The vast majority of adult Saint John River salmon pass through the Study Area from June 1 to July 15. Kelt (spawned-out) salmon and newly recruiting juveniles (smolts) are thought to return to the ocean, and pass through the Study Area in from late May to early June.

The smolts of these stocks enter the sea in May. Post-smolt tag returns indicate that the fish may be concentrated in or near the Study Area in late August and September.

5.5.2 Fisheries

Fishery resources, including recreational, commercial, and Aboriginal/First Nations fisheries are described below.

5.5.2.1 Recreational Fisheries

There is a small recreational fishery for striped bass, which is conducted at Reversing Falls. The community group involved is the Reversing Falls Striped Bass Anglers' Association. The retention limit for the fishery is one fish greater than 68 cm in length per day (AMEC, 2000b). There is also a popular winter fishery for smelt that is conducted in Grand Bay and Kennebecasis Bay. This fishery may be conducted near the northern end of the Study Area in Grand Bay.

In the marine environment, there are recreational fisheries for groundfish, primarily cod, flatfish (flounder species), and mackerel that occur within the Study Area.

5.5.2.2 Commercial Fisheries

The marine portion of the Study Area is part of the Bay of Fundy, which is in the North Atlantic Fisheries Organization (NAFO) Conservation Area 4X. Groundfish, pelagic species and shellfish are fished in the Study Area. Landed weights and values for the New Brunswick portion of this region for 2000 totaled 51,330 tonnes and approximately $38 million, respectively.

Landed weight for important commercial marine species are presented in Table 5.6.

TABLE 5.6 Landed Weight and Value of Important Commercial Fish Species on the Fundy Shore of New Brunswick in 1999 and 2000 (Source: DFO, 2001a)

Year	1999		2000	
Species	Weight (tonnes)	Value (1,000)	Weight (tonnes)	Value (1,000)
Marine Plants	6,881	$602	7,886	$764
Shellfish Species				
Lobster	1,848	$25,170	1,628	$22,462
Sea Urchin	1,713	$4,097	1,408	$3,693
Crab	246	$253	441	$694
Scallop	1,464	$3,806	1,483	$3,499
Clam	245	$534	85	$163
Pelagic Species				
Herring	39,360	$6,298	37,425	$5,743
Mackerel	15	$7	0	$0
Groundfish Species				
Pollock	162	$298	115	$212
Cod	165	$450	188	$347
Haddock	20	$64	31	$100*
Hake	12	$13	36	$39
Flatfishes	24	$43	17	$31
Dogfish	16	$6	97	$36
Total Groundfish	405	$907	490	$765

Note 1. Hake, haddock, flatfish & dogfish values have been extrapolated from 1999.

Shellfish

By far the most lucrative fishery in the Study Area is for lobsters. Within the last 20 years, lobster catches have increased from 5,000 lb per boat for the spring and fall seasons combined, to 20,000 lb per boat for each of the spring and fall seasons (G. Thompson, personal comm., 2002). There are at least 45 boats that fish within the Study Area, and the entire area outside of Saint John Harbour is fished (G. Thompson, pers. comm., 2002). The area off Saint John Harbour within the Study Area is the most productive portion of Lobster District (LD) 36, which extends from the Maine/New Brunswick border to Fundy National Park. There are 170 licensed lobster fishermen in LD 36, 161 of which are single full-time, 7 of which are partnership (full-time), and two of which are part-time (DFO, 2001b). The fall season in LD 36 commences on the second Tuesday of November, and closes on January 14. The spring season in the district opens on March 31, and ends on June 30 (DFO, 2001b).

Another important shellfish species in the region is the green sea urchin, which is harvested for its roe. The fishery is managed according to Lobster Fishing Areas, or Lobster Districts. The Study Area is within LD 36, which also incorporates the outer Fundy coastline region, including Passamaquoddy Bay (DFO, 2000). This outer Fundy region is more productive than the Study Area for sea urchins. The fishery for sea urchins within the Study Area is almost non-existent (S. Robinson, pers. comm., 2002).

The third important shellfish in the New Brunswick Fundy fishery is the sea scallop. The fishery is managed by limiting entry, by quota, and by gear restrictions. Quotas are applied according to Scallop Production Areas (SPAs), with the Study Area being included in SPA 6, sub-Area C. This sub-area encompasses the near-shore region from the Maine/New Brunswick border to Cape Spencer (just west of the Study Area), with the southern boundary defined by a line from Cape Spencer, to the Wolves, then to the northeast tip of Campobello, and along the north coast of this island, back to the border. Two fleets, the Mid-Bay fleet, and the Full Bay fleet fish scallops in SPA 6. The main portion of the fishery is conducted in the western part of the production Area, however, scallops are dragged around Split Rock within the Study Area (G. Thompson, pers. comm., 2002). In addition, new scallop beds can appear suddenly after successful and unpredictable recruitment occurs. One such incident resulted in a very productive bed supporting a very lucrative fishery off Cape Spencer in the late 1980's (S. Robinson, pers. comm., 2002).

Lobster, scallop and dogfish are commercialy fished in the vicinity of the Monobuoy. There are two lobster seasons in the area, April 1st to June 29th and from the 2nd Tuesday in November until January 4th. Approximately 15 lobster fishing vessels partake in this fishery (AMEC, 2002a).

Scallop dredging occurs from the 2nd Tuesday in January until April 1st. Approximately 15 to 20 fishing vessels partake in this fishery.

Marine Plants

Rockweed is the most important marine plant that is now harvested in the Maritimes. Sodium alginate (seaweed extract) and kelp meal are produced from it. Rockweed grows in the inter-tidal zone in moderately exposed areas (*i.e.*, on rocks). The Study Area is within Rockweed Management Area 6, sub-Area A (the New Brunswick Bay of Fundy Coast east of Passamaquoddy Bay). This sub-Area has only 10% of the harvestable rockweed in the entire Area. The management of the resource is by license, and annual harvest levels, with 17% of the total biomass being the accepted annual harvest (DFO, 1998). The very conservative 10,000 tonne annual limit for New Brunswick has never been achieved (G. Sharp, pers. comm. 2002). Dulse is also harvested in the intertidal zone of the Study Area outside of Saint John Harbour.

Groundfish

The Study Area is within NAFO Division 4Xs (essentially the New Brunswick side of the Bay of Fundy). Cod grow rapidly in the Bay of Fundy, however, the fishery has declined precipitously since the 1960s when large off-shore trawlers entered the fishery. This NAFO district shares a quota with the entire Scotia-Fundy shore and the Canadian portion of the Gulf of Maine (Divisions 4X and 5Yb, essentially from Halifax to the Maine/New Brunswick border). In the 1960s, 14,000 to 36,000 tonnes were taken from this District. In 2000, the total allowable catch (April 1 - 2000 to March 31 - 2001) was 6,000 tonnes (DFO, 2000a). In the vicinity of the Study Area, groundfish fishing occurs in the late winter and spring at least 6 miles (10 km) off shore, past the Musquash Shoals (G. Thompson, pers. comm., 2002). It is not a major fishery in the Study Area.

The fishery for dogfish occurs from July 1st until the area quota (62 tonnes) is filled. In the year 2001, the dogfish season lasted approximately 11 days. The dogfish fishery is located approximately 2 miles south of the Monobuoy and includes the use of gill nets and long lines (R. Hunt, pers. comm. 2002). Approximately 10-12 fishing vessels partake in this fishery, however only 2 vessels regularly fish in the vicinity of the Monobuoy. The remainder of the vessels typically fish off of Point Lepreau.

Pelagics

The principal pelagic fish targeted in the Study Area is the herring. The Bay of Fundy fish are included in the Southwest Nova Scotia spawning component, the biomass of which was estimated at 520,000 tonnes in 1999. The fishery is managed by total allowable catch, with an allocation made between mobile and fixed gear fishermen. Herring catch in southwest New Brunswick declined in the late 1990s from an average of 26 thousand tonnes from 1970 to 1995 to 16, 21 and 20 thousand tonnes respectively in 1996, '97 and '98. The herring fishery in the Study Area is no longer very important. There are no weirs there any more, and very little drift netting is conducted within the Study Area. The Study Area is an important over-wintering and nursery area for herring (G. Melvin, pers. comm., 2002). Because the market for herring changed from demanding small fish to demanding larger fish, the smaller fish that inhabit the Study Area were no longer in demand. This is the reason that fishing effort in the area has declined (G. Melvin, pers. comm., 2002).

Diadromous

Commercial fisheries for diadromous species occur throughout the lower Saint John River, including Saint John Harbour, and the lower end of Grand Bay within the Study Area. The principal commercial species sought are gaspereau (two species: alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*)), shad (*Alosa sapidissima*) and American eel (*Anguilla rostrata*). Gaspereau may be fished from January 1 – June 30, and shad from May 1 – June 30. However, the fishery is typically closed as soon as the first returning Atlantic salmon are seen in the Harbour in late May. Eels are fished in freshwater from April to October, and sometimes into November. The commercial fishery is conducted using a variety of trap nets for gaspereau, shad and eels. Fixed and drifting gill nets are used in the harbour for gaspereau, and shad (Dillon Consulting Ltd., 2000; G. Thompson, pers. comm., 2002).

5.5.2.3 Aboriginal/First Nations Fisheries

The Oromocto Indian Band and the Aboriginal Peoples Council conduct food fisheries during April to October in the Saint John River. These fisheries depend on species that migrate through the Study Area. Trap nets are typically used to catch shad and gaspereau, and an increasingly important First Nations' fishery now occurs for eels (AMEC, 2000), which are catadromous fish. The once important fishery for Atlantic salmon has been closed indefinitely because of the low numbers of fish that are returning from the high seas.

5.5.2.4 Aquaculture

The aquaculture industry provides over 2,000 direct jobs and 1,600 indirect jobs in the Atlantic region. More than 90% of these jobs are in rural and coastal communities. Aquaculture now represents 23% of the total value of all fish supplied at the harvesting level in the Scotia-Fundy fisheries area. In New Brunswick, almost all the value of aquaculture production is derived from Atlantic salmon in the Bay of Fundy. In 1999, estimated sales of farmed salmon was $150 million. Oysters and mussels comprise the remaining production (DFO, 2002).

5.6 Designated Areas and Other Critical Habitat Features

Available information on designated areas and other habitat features identified as sensitive or critical was compiled and reviewed to determine their location in the Study Area (Clayden, *et al.*, 1984 and NTNBI, 1995). Designated areas may include National/Provincial Parks, conservation areas, significant natural areas, ecological resources, wildlife management/protection areas, national wildlife areas/migratory bird sanctuaries, or environmentally significant areas (ESAs).

Environmentally Significant Areas (ESAs)

ESAs in New Brunswick are designated by NBDELG as having at least one of the following characteristics (NTNBI, 1995):

- natural areas that are considered to be ecologically fragile with respect to human activities;
- areas that provide habitat for rare/endangered species;
- areas that have unique, or specially distinctive, natural features of biological, ecological, geological, or aesthetic value; and
- areas that have been enhanced through implementation of specific habitat management strategies aimed at specific species and/or ecosystems.

Twelve ESAs are located within the Study Area as follows:

- Reversing Falls and Outcrop Islands – located in West Saint John, off Chesley Drive. Known for specimens for three invertebrate fossils, and Lower Ordovician shale in fault contact with Precambrian limestone. The outcrop islands include Goat, Middle and Crow Islands, located off Prospect Point. All serve as feeding and nesting sites for gulls, terns, and cormorants, which feed on fish coming to the surface with rapids. This area is also considered a good vantage point from which to observe ducks and gulls in the winter.
- Red Head Marsh – located in East Saint John on the Saint John Harbour, encircled by the industrial developments of the Grandview and McAllister Industrial Parks. A Ducks Unlimited impoundment has made this one of the few freshwater coastal marshes in New Brunswick. It is highly productive, and very important for a variety of breeding birds. Tidal flats offer some shorebirds (reduced due to pollution) from mid-July to October. Species of concern in this area include the least bittern, marsh wren, virginia rail, and the black-crowned night-heron.
- Courtenay Bay – located in East Saint John. It is a tidal bay and sewage mud flat known for fall concentrations of shorebirds, especially semipalmated plover, and as a winter feeding area by gulls and ducks (mainly black ducks and common goldeneyes). Six species of gulls, including Iceland, glaucous and black-headed, may also be seen.
- Fern Ledges – located at the Seaside Park shoreline between Bay Shore and Duck Cove, Saint John. This site is characterized by exposures of Pennsylvanian grey sandstone and shale. It is the type locality for a least 40 species of fossils, particularly plant and invertebrate fossils, that are maintained in the collection of the New Brunswick Museum.

- Duck Cove – located on the shoreline at Duck Cove in West Saint John. This site is the type locality for at least 6 species of plant and invertebrate fossils that are maintained in the collection of the New Brunswick Museum.
- Greenhead Cave – located several hundred meters back from the shore overlooking the Saint John River in the abandoned J and F Armstrong limestone quarry. This is a solution cave on Precambrian limestone that supports small numbers (1-25) of the bats *Myotis septentrionalis* and the rarer *Pipistrellus subflavous*.
- Black Beach Headlands Park – located on the east shore of Musquash Harbour from Black Beach to Musquash Head. The Bay of Fundy Project has proposed the creation of a nature park here encompassing the rare charcoal black beach and steep cliffs of Musquash Head. This is the only black beach on the Fundy coast. The beach slopes gently to the unspoiled Musquash estuary, which contains extensive salt marshes and intertidal areas.
- Saints Rest Marsh and Beach – located on the tidal mud flats in West Saint John that extend from Manawagonish Cove to Lorneville Harbour. The Saints Rest Marsh (approximately 21 acres of salt marsh) is a nature preserve owned by the Nature Trust of New Brunswick. The Marsh and Beach area includes a sandy beach and mudflats, flanked by rocky beaches and points and backed by the marshes along the Manawagonish River, providing an interesting diversity of habitats. This is a Class 1 salt marsh and is the last remnant of extensive tidal marshes historically in Saint John. This area is considered an important feeding and roosting site for migrating waterfowl and shorebirds in the spring and fall. It supports 234 species of bird life, representing 65% of the provincial bird fauna, and is considered one of the best places in New Brunswick for the following birds: black ducks, American wigeon, savannah sparrow, great egret, snowy egret, glossy ibis, tricolored heron (seen at intervals of 5-6 years). This area is used by at least 20,000 shorebirds during autumn migration and saw a maximum of 111,500 birds in 1986. A rich variety of plant life is also found in the area. Late Wisconsin fossiliferous marine sediments are exposed in the cliffs along the beach, attesting to past higher sea levels.
- Manawagonish Island Nature Preserve – located in the Bay of Fundy, 1.5 km south of Saint Rest Marsh/Beach in West Saint John. The island is approximately 20 hectares in size and is an important breeding site for cormorants, great blue herons and various gulls. It is also the site for sightings of several uncommon birds including the glossy ibis and the gadwall duck. This area is a nature preserve owned by the Nature Trust of New Brunswick.
- Saint John Cambrian-Precambrian Border – Geological sites of interest include Fort Howe Main Street, Rockwood Park Trailer and Camp Group, UNBSJ, and Martello Tower Fundy Heights. The area of interest shows Cambrian and Lower Ordovician rocks uncomformably overlying Precambrian volcanics. Saint John is one of the few places in the world where this important transition in geological time is exposed. Several invertebrate fossil type specimens have been collected from King and Seeley Streets.
- Irving Nature Park (Taylors Island) – located just south of Saints Rest in West Saint John, forming the eastern boundary of Lorneville Harbour. The peninsula is forested with upland forest, and serves as an important resting and feeding site for migrating birds. More than 240 species of birds are seen regularly and a total of 365 species (2/3

of all bird species in North America) have been sighted there. Wooded areas serve as a shelter for many unusual wildflowers and fungi. Offshore rock outcrops are used by harbour seals.

- Musquash Harbour and Island – located in Musquash Harbour in West Saint John. The harbour has considerable salt marsh, including the well-protected Hepburn Basin, and large intertidal flats. One pair of bald eagle nests on Musquash Island. The Island serves as an important migration habitat for a variety of birds, particularly as a breeding and staging area for black duck, blue-winged teal, wood duck, and common goldeneye. Musquash Ledges, just south of the Island, are used as seal haul-out rocks.

There are no other designated areas, or sensitive or critical habitat features located within the Study Area.

5.7 Socio-Economic Setting

The following sections describe the socio-economic setting of the Study Area.

5.7.1 Population and Labour Force

This section describes the current demographic characteristics and trends for Saint John County, and the Saint John Census Metropolitan Area (CMA).

The population of the Saint John CMA increased from 1986 to 1992 but from 1993 onward a decline in the population has occurred. This decline is not substantial as it amounts to only a 1.6% decrease in the population. In Saint John County the population experienced a decrease of 3.9% from 1992 onward.

According to Statistics Canada, the labour force for the Saint John CMA has increased from 63,900 in 1996 to 72,500 in 2000. NB Power is the 7th largest employer (Table 5.7) in the region with approximately 1000 employees (700 employees, Point Lepreau Generating Station; 140, Coleson Cove and Courtenay Bay Generating Stations and 100 employees, customer service).

5.7.2 Industry and Commerce

The following sections provide a summary of industrial and commercial information for the Saint John CMA.

The Saint John CMA is New Brunswick's largest urban centre. It serves as a regional service centre; a transportation hub for road, rail and port for goods being exported from and imported into the country, and as a distribution centre for the delivery of goods throughout the region. It acts as a regional commercial centre for retail and wholesale activities servicing a marketing area of about a 50-mile radius in which approximately 140,000 people live. The CMA is a tourist and convention centre, a regional and, in some cases, provincial government centre. It contributes approximately 33% to the province's total Gross Domestic Product (GDP) and its largest employers are the health centre, Canada's largest oil refinery, a pulp and paper mill, a major shipyard and clusters of plastic, packaging, food processing and metalworking companies. In the last few years, large international call centres such as Xerox, IBM, and Air Canada, Nortel Networks, Cendant, TD- Canada Trust and Liberty Mutual have established themselves in the area.

TABLE 5.7 Major Employers, Saint John, New Brunswick

No.	Business
1	Saint John Regional Hospital
2	Board of School Trustees – Dist. #6 & 8
3	New Brunswick Telephone Co. Ltd.
4	JD Irving Ltd.
5	Irving Oil Limited- Refining Division
6	City of Saint John
7	NB Power
8	Cendant
9	Xerox
10	RMH Teleservices
11	Baxter Foods Ltd.
12	Air Canada
13	Irving Oil Ltd.
14	Workplace Health & Safety
15	Revenue Canada Taxation
16	Brookville Carriers
17	Moosehead Breweries
18	Spiegel Group Tele-Services
19	Dept. Health & Community Services
20	Canada Post

Source: M. Robichaud, pers. comm., 2001.

Future industrial growth is anticipated to be in the telecommunications/information technology, plastics and metalworking industries. Other new construction activity being contemplated include a new police station, a new office building, a new hotel, a major harbour front development and 250 - 300 new housing starts.

5.7.3 Existing Marine and Land Use

The following sections describe existing land use for the Study Area including industrial and commercial, housing, cultural/industrial, recreational, agricultural, forestry, transportation, and associated infrastructure.

5.7.3.1 Industrial and Commercial

Two industrial parks are located in Saint John. Spruce Lake Industrial park is located in the west end close to the CCGS. It consists of 210 ha of which 42 are serviced with an expansion capability of 1,000 ha. The cost in 2001 was $25,000 per acre. McAllister Industrial Park is located in the east end close to the Saint John airport. It consists of 150 ha of which 50 are serviced with an expansion capability of 100 ha. The cost in 2001 was $25,000 per acre. Spruce Lake can accommodate expansion.

The Saint John CMA has three business parks: Somerset Technical Park, Millennium Business Park and Commerce Park. All parks can accommodate expansion.

The Saint John Port Authority is a locally managed international seaport providing intermodal transportation links to a market of 100 million consumers. The port of Saint John is one of the oldest and most active seaports on the Atlantic seaboard, handling an average of 20 million metric tones of cargo (break bulk – forest products and steel, containerized, and bulk – petroleum, potash, salt) annually. Located in the Bay of Fundy, the Port of Saint John has 27 berthing facilities and a docking front of 3865 m.

5.7.3.2 Housing

Information on housing is drawn from the 1991 and 1996 Census, from data compiled by the Canada Mortgage and Housing Corporation (CMHC) and from data compiled by the Canadian Real Estate Association.

In 1996, the number of occupied private dwellings in New Brunswick was 271,155 with 47,055 or 17.4% of these being in the Saint John CMA and 29,315 or 10.8% of these being in the City of Saint John. The NB Second Quarter 2000 Housing Now reports single starts are up 17% from 1999 in New Brunswick. Of the total number of single starts in the province, 59% were urban and 41% were rural. Housing Now predicts that positive net migration will continue to support the resale housing market.

Housing Price and Sales

The NB Second Quarter 2000 Housing Now states that the percentage increase in the average price of residential units between 1995 and June 2000 in Saint John is 12.6%. The average house price in Saint John increased by $6,610 from 1998 to 2000.

Rental Market

New Brunswick had the 5th (out of 11) highest vacancy rate in Canada. Apartment vacancy data for New Brunswick indicates that the number of rental units available dropped by 1.2% between 1999 and 2000 from 4.3% to 3.1%. Out of Canada's 27 largest CMA's, Saint John had the 5th highest vacancy rate in 1999, but that changed to 7th in 2000. In Saint John, the vacancy rate dropped 1.8% from 5.2% to 3.4% in 1999 and 2000 respectively. This drop was caused by refinery expansion, highway projects and developments in the high technology sector. This growth has discouraged some people from leaving the area and has attracted others from elsewhere and around the province to rent in the Saint John area.

According to the CMHC, a decline in the vacancy rate has occurred as a result of an increase in rental demand with no new substantial rental developments. Generally with a low vacancy rate, rents increase, but with high levels of affordability for buying a home in the Saint John area, landlords have been reluctant to increase rents. This resulted in only 1% increase in rental rates between 1999 and 2000 (from $438 on average per month to $442). The decrease in vacancy rates occurred in the area with the greatest activities including the east side near the oil refinery and the north end where a major influx of international students occurred at UNBSJ.

A range of term and temporary accommodations is available in Saint John, including hotels/motels, country inns, bed and breakfasts, tourist home, cottages, and camp grounds. For

Saint John, the average occupancy rate during 2000 varied from a low of 54% during November, to a high of 93% during August. The average occupancy rate for Saint John was 87%, the highest ever for the city.

5.7.3.3 Land Use and Zoning Controls

The Municipal Development Plan, adopted by Common Council, is the policy document which describes how the City intends to develop in the future, and generally establishes a broad planning framework to manage the future growth and change of the City, as well as provide policy guidance on a variety of land use and development related issues.

The only new Project element is the pipeline from Canaport to Bayside Drive. The preferred conceptual route for this pipeline, for the most part, follows existing right of ways and industrial infrastructure.

5.7.3.4 Cultural/Institutional

Cultural/institutional land use infrastructure is provided in the following sections, for medical and health services/facilities and educational services/facilities.

Medical and Health Services and Facilities

Medical and health services and facilities in Saint John are provided by the Atlantic Health Sciences Corporation (AHCC). Services provided include acute care, provincial referral services and emergency care. The Saint John Regional Hospital is the primary and largest provincial hospital and specializes in cardiac care, neurosciences and cancer treatment. Saint Joseph's provides general and women's health services.

The AHCC employs approximately 4300 people with the majority of them located on site at the Saint John Regional hospital, making it the largest single employer in the area. Shortages facing the health care system in this region include insufficient nursing home beds for an increasingly aging population, general practitioners as many of them are close to retirement age, and depending on the area, some specialists in such fields as acute and psychiatric care.

Educational Services and Facilities

The projected enrolment for K-12 for all of New Brunswick is expected to drop from 125,850 to 100,160 between 2000 and 2011. Nonetheless, a shortage of teachers exists as many are reaching retirement age. Upwards of 100 are due to retire during 2001.

Two school districts cover the region from Saint George to Saint John, (School Districts 6 and 8). District 6 (north east of Saint John) consists of 18 schools (one primary, eight elementary, four middle and four high schools and one elementary and middle), had an enrolment of 8,054 for the school year 1999/2000, 468 full-time equivalent educators and 203 non-educational and support staff. District 8 (Saint John and to the west) covers the area from Maces Bay to Saint Martin's, and consists of 56 schools (four primary French immersion, one primary, one primary-middle French immersion, 21 elementary, five middle French immersions, six middle schools, eight elementary/middle schools, five French immersion high schools and five high schools) and had an enrolment of 14, 571 for the school year 1999/2000, 880 full-time equivalent educators and 410 non-educational and support staff.

Both school districts have emergency measures plans, as does each school. Emergency measure exercises are carried out annually.

The school population for the Saint John CMA has dropped from approximately 25,000 twenty years ago to approximately 15,000 today as a result of a relatively stable population, but a decrease in the birth rate. During this time period approximately five schools have closed and no new schools have been built resulting in excess available classrooms. The school boards have consolidated schools where possible.

Post-secondary education in Saint John is provided primarily through UNBSJ, New Brunswick Community College Saint John (NBCCSJ) and 15 private training institutions. NBCCSJ is the largest of the New Brunswick Community Colleges, has 1,300 full-time students and offers 24 full-time programs including business technology, chemical technology (co-op), computer programming technology, industrial control technology (co-op), industrial mechanics, machinist, mechanical engineering technology, mechanical technician, and power engineering technology. The full-time enrolment at the UNBSJ Campus and Community College campus has decreased from 7,133 students to 6,796 students over the past five years.

5.7.3.5 Recreational

There are campgrounds located throughout the southern coast from St. Stephen to Saint John. There are no campgrounds located within or adjacent to the Study Area (2001 New Brunswick Travel Planner and the Saint John Visitor and Convention).

5.7.3.6 Agricultural Land

There is no agricultural activity within the Study Area.

5.7.3.7 Forestry

Based on Forest Inventory Maps and aerial photos, the area of forested land in the Study Area (from Canaport to the IOL refinery) is approximately 14 km^2. Forestry operations on private woodlots are not legislated, and do not require that a management plan be submitted to NBDNRE. Therefore, private woodlot operations do not have to adhere to habitat requirements set out by NBDNRE. However, the majority of the Study Area has been cut historically, and has been converted to predominantly softwood stands for the purpose of fibre production.

5.7.3.8 Transportation Infrastructure

Information on highway, rail and/or transportation related infrastructure is provided in the following sections.

Highway

The City of Saint John is served internally by a comprehensive network of arterial and collector streets and roadways. The city also has good access to the Provincial highway system. The McKay Highway (Route 1), is a fully access controlled grade-separated throughway that extends from east to west through the City, connecting the US to the west, with the Kennebecasis Valley, Moncton and the Atlantic Provinces to the east. The only interruption along Route 1 is the tollbooth at the Harbour Bridge, which charges a 25 cent toll in each direction. Access to Fredericton is provided by Route 7, which is an access controlled grade-separated highway within the City. Route 111 at the east end of the City provides direct access to the Saint John Airport from Route 1. Route 100 also provides east-west access through the City and is the main access route to many of the City's commercial and industrial areas, including the downtown.

Rail

Saint John, New Brunswick is the only major urban centre in Atlantic Canada served by competing international rail networks (CN Rail and NB Southern Rail (NBSR)). CN continues to operate in New Brunswick, although it mostly exists as the main line between Montreal, Quebec and Halifax, Nova Scotia, with a branch line down to Saint John (NB Railways Map – Web page (http://www.theboykos.com/nbrr/map.html, 2002). The NBSR rail line has direct rail access to New England through McAdam and operates local bulk product transfer facilities. NBSR operates the Saint Stephen Subdivision line from McAdam to Saint Stephen (Milltown). NBSR is exclusively a freight shipment facility. CN terminates in Saint John, with freight transported on this portion of the line from Montreal, Quebec and Halifax, Nova Scotia. Passenger travel on the CN line is through VIA Rail and departs out of the Moncton Terminal for Montreal and Halifax.

Air

The Saint John airport is the major regional airport servicing the region. Employing 22 people, the airport has approximately 13 inbound flights and 13 outbound flights per day depending on the season. Daily jet service is provided to Halifax, Montreal and Toronto and daily intra-provincial service is provided. The airport services national passenger aircraft, most charter flights and air cargo traffic. General aviation activities including military, government, private aircraft and helicopter services can be accommodated at the airport.

Marine

The Port of Saint John is divided into three main areas: the Main Harbour, Courtenay Bay, and the Outer Harbour. The majority of Port facilities are located in the Main Harbour and Courtenay Bay. The Outer Harbour is comprised of the Harbour approaches and anchorage areas. A Single Buoy Mooring (SBM), or monobuoy at Canaport is also situated in the Outer Harbour, approximately 1,000 meters offshore for receipts of crude oil for the Irving Refinery.

Vessels arriving at the Harbour enter the Main channel, which is dredged to 9 m below chart datum, at Partridge Island and proceed into either the Main harbour or Courtenay Bay, an area of substantial industrial activity, including a potash terminal and oil handling facilities. Consequently, traffic density is at its highest point in the short stretch of channel past Partridge Island.

Vessels operating in the Port of Saint John Harbour consist of Bulk Carriers, Container Ships, Ferries, General Cargo (or Break Bulk) Ships, Forest Product Ships, Passenger Ships, Roll-on/Roll-off (RO-RO) Ships, Tank Ships, Tugs and Barges. Additionally, recreational vessels operate throughout Saint John Harbour during the summer months.

A ferry operates year-round between Saint John and Digby, Nova Scotia, departing twice per day during the winter and three times per day during the summer.

The commercial fishing fleet in the Bay of Fundy, some of which utilizes Saint John Port as a "lay port" and fishes the surrounding area[1], amounts to about 2,700 vessels, 2,600 of which are less than 15 meters in length. The remainder of the fleet is composed of vessels less than 30 meters in length.[2]

Table 5.8 shows the size of ships (exclusive of fishing and recreational vessels) arriving at Saint John Port, including the Canaport monobuoy, during the three-year period from 1998 to 2000.

TABLE 5.8 Vessel Sizes at the Port of Saint John, NB - 1998-2000 (Gross Tons (grt))[3]

	Minimum	Maximum	Mean
Barges	148	10,691	4,024
Bulk Carriers	3,969	41,173	21,196
Container Ships	8,106	16,202	11,560
Ferries	1,443	13,179	9,960
General Cargo	818	36,008	11,380
Forest Products	11,896	36,008	26,783
Passenger Ships	8,378	101,509	47,733
RO/ROs	2,592	54,826	25,777
Tugs	71	1,180	307
Tankships Canaport	63,515	187,421	121,017
Tankships Saint John Harbour	1,662	21,673	8,387
Tankships Courtenay Bay	5,742	32,612	19,515

Source: Saint John Port Authority

In Saint John Harbour, essentially all of the crude oil ships are double hulled, as opposed to fuel oil ships, the majority of which are single hulled. International requirements are also causing the replacement of single hull product tankships with double hull tankships, although some single hull ships are still operating in the Port.[4] Other ships operating in Saint John Port typically have single hulls, except in way of the engine room, which will have a double hull. That space between the double hull, however, is used for fuel oil storage.

Vessel arrivals at facilities around Saint John Port are fairly evenly distributed between the Main harbour and Courtenay Bay. There are about 300 ship arrivals per year in the Main harbour and a similar number in Courtenay Bay. Tugs account for an additional 100 arrivals, mainly in the harbour. Canaport represents a separate facility and historically has received 20 to 60 VLCCs annually.

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[1] Fishing vessels are not "home ported" at Saint John Port, but operate in the vicinity of the port during the lobster and herring seasons.

[2] Department of Fisheries and Oceans, Resource Management-Atlantic, August 2000.

[3] One "Gross Ton (GRT) is equal to 100 Cubic Feet of cargo carrying capacity.

[4] The International Maritime Organisation has developed regulations implementing The International Convention on the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78) that generally require all tankships to be of double hull construction by 2015.

Table 5.9 shows the number of ship arrivals in Saint John Port, as recorded by the Saint John Port Authority.

TABLE 5.9 Vessel Arrivals Port of Saint John, NB - 1998-2001

	2001	2000	1999	1998	Total
Bulk Carriers	62	78	94	86	320
Container Ships	50	50	52	56	208
Ferries	13	14	12	12	51
General Cargo	57	58	59	48	222
Forest Products	5	10	16	25	56
Passenger Ships	53	68	30	24	175
RO/Ros	48	62	35	48	193
Total Nontankship arrivals	288	340	298	299	1225
Tankships Canaport	63	40	25	22	150
Tankships Saint John Harbour	20	30	33	29	112
Tankships Courtenay Bay	463	290	308	301	1362
Barges	78	54	64	103	299
Tugs	112	72	98	142	424
Total all vessels	1024	826	826	896	3572

Source: Saint John Port Authority

The Port of Saint John is situated at the upper end of the Bay of Fundy. All power vessels greater than 20 metres in length in the Bay of Fundy operate under a compulsory traffic routing system, including a traffic separation scheme (TSS) and mandatory checkpoints, locally referred to as "Fundy Traffic".[5] There are no known navigational hazards or maneuvering problems along the route from the entrance of the TSS into the Bay of Fundy to the Port of Saint John.

An "exclusion zone" with a radius of about one-half mile encircles Canaport, which is put into effect whenever a tankship is moored to the SBM. All vessels, including fishing vessels and their gear, must remain out of the exclusionary zone while a tankship is moored to the SBM.

Saint John Port is designated as a compulsory pilotage area. No vessel is authorised to operate unless under the direction of a licensed pilot.

The Marine Communications and Traffic Services (MCTS) at Saint John works with the pilots to minimise potential meeting situations during the passage into Saint John Harbour.

The Harbour Master for Saint John Port promulgates "Practices and Procedures" for the ports which establish safe operating practices to which every vessel within the limits of the port must comply. Special instructions from the Harbour Master to vessels operating within the port limits are passed by MCTS.

There has been only one reported incident in the project area in the past twenty years. The tanker *Severn* was at anchor on December 18, 2000 in Anchorage Area "B". At about 0300, the *Severn*'s anchor failed to hold during high winds causing it to drift into the tanker Irving Primrose also at anchor. As a result of the incident, the Irving Primrose, a double-hulled tanker, suffered minor damage to the starboard side outer plating. No oil was released as a result of the incident and no injuries or other damages were reported.

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[5] Fishing vessels are allowed to fish in any direction near a TSS.

5.7.3.9 Other Infrastructure

Additional infrastructure present within or overlapping with the Study Area may include electrical, water/sewer, communications, natural gas, fuel oil pipelines, and utility corridors.

5.7.4 Existing Public Health and Safety Concerns

The baseline conditions for community health in the Study Area are described in detail in the Human Health Risk Component Study.

5.7.4.1 Existing Road Infrastructure and Levels of Service

Traffic associated with the Project will utilize the following sections of existing highway:

- Route 1 (four lanes, divided) between the Market Place interchange and the Route 7 interchange (22,700 vehicles daily);
- Route 1 (four lanes, divided) between Route 7 and King William Road (7,000 vehicles daily);
- Route 7 (four lanes, divided) between the Route 177 interchange and Route 1 interchange (12,900 vehicles daily);
- King William Road (two lanes) between Route 1 and the Lorneville Road (4565 vehicles daily);
- King William Road (two lanes) between Lorneville Road and the CCGS (1360 vehicles daily); and
- Market Place (two lanes) between Route 1 and the West Saint John Port Terminals (8,000 vehicles daily).

Level of service (LOS) is the measure of traffic operating conditions during peak traffic periods, and is based on the volumes of traffic and the capacities, geometrics and control elements of urban street intersections or rural highways. The existing LOS for the road sections listed above range from good to excellent.

All routes required for this Project are considered to be in good condition strength wise, and can accommodate gross vehicle masses of 62,500 kg with no spring weight restrictions put in place. The pavement quality on Routes 1 and 7 is good and visual observations for King William Road and Market Place indicate the surface conditions are fair to very good.

Traffic Safety

Accident rates are typically higher in urban areas and for two-lane highways, as compared with rural area divided highways. Present accident levels along the primary highways within the traffic impact area indicate no unusually high safety risk. Accident rates along the traffic impact area segments of Route 1 and Route 7 range in the 0.46 to 0.67 accidents per million vehicle-kilometres. This is in contrast with the two-lane segment of Route 1 in the St. Stephen area, where the accident rate is 4.48 accidents per million vehicle-kilometres.

Accident data were requested from the Saint John City Police for King William Road and Market Place. The year 2000 accident reports indicate two minor accidents at the Market Place and Route 1 ramps and no accidents along King William Road.

Most accidents within the traffic impact area have involved property damage only, and practically all did not involve fatalities. Only 2% of the accidents on the Route 7 segment have involved a fatality, which is about the Provincial average. None of the accidents along the segments of Route 1 from King William Road to the Market Place interchange involved a fatality. Table 5.10 presents the average accident rates and the average annual accident occurrence, as well as the past 5 years average breakdown of accident severity for the traffic impact area.

5.7.5 Noise

Noise can be defined in two ways: (1) an unwanted sound; and (2) a sound, generally of a random nature, the spectrum of which does not exhibit distinct frequency components. The A-weighted scale (dBA), devised by researchers and commonly used in sound measurement, approximates the response of the human ear to sound. A 10 dBA increase represents a doubling of the noise level while a 10 dBA decrease results in a halving of the noise level.

Traffic Noise

Noise sensitive areas (NSAs) are defined in the Department of Transportation Highway Noise Mitigation Guidelines as residential development areas which are located adjacent to a highway. NSA candidate sites were selected for evaluation purposes and identification of noise impacts resulting from the Project.

To provide an indication of existing (ambient) noise levels, a noise meter reading was completed at each NSA to determine the A-weighted 24 hour continuous noise level (L_{eq} 24). This value is the level of the continuous sound which has the same energy as the actual time varying sound over the 24 hour period being considered. The A-weighted decibel dBA is a frequency weighting which approximates the relative sensitivity of the normal human ear to different sound frequencies.

Table 5.11 summarizes the L_{eq} 24 dBA ambient (existing) noise readings obtained at each site. The readings range from a low of 45.7 dBA to a high of 65.9. The highest reading represents a loudness four times that of the lowest[6].

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[6] An increase of 10 dBA represents a doubling in sound.

TABLE 5.10 Existing Accident Occurrence Along Traffic Impact Area Highway Segments

Impacted Highway Links	Existing Average Annual Accident Rate (Accidents per Million Vehicle-kms)	Existing Traffic (average annual daily traffic)	Length of Highway Link (kms)	Existing Accident Occurrence per Year	% Accident Severity		
					Property Damage Only	Personal Injury	Fatalities
King William Road – Coleson Cove to Lorneville Road	0	1,360	6.2	0	N/A	N/A	N/A
King William Road – Lorneville Road to Route 1	0	4,565	1.4	0	N/A	N/A	N/A
Route 1 - King William Road to Route 7	0.67	7,000	2.3	3.94	79%	21%	0%
Route 1 - Route 7 to Market Place Interchange	0.67	22,700	6.8	37.75	73%	27%	0%
Market Place –Route 1 to West Saint John Port Terminals	0.68	8,000	1.0	2.0	100%	0%	0%
Route 7 – Route 1 to Route 177	0.46	12,900	7.6	16.46	55%	43%	2%

TABLE 5.11 Measured Ambient Noise Levels At Selected Noise Sensitive Areas (NSAs)

NSA Number	NSA Description	NSA Distance to the Closest Lane of the Highway Network in Meters	L_{eq} 24 (dBA)
1	Located at the end of Prince Street	25.8	63.4
2	Located at 306 Prince Street	35.2	65.9
3	Located at 108 Prince Street	31.3	53.6
4	Located at 208 King Street	34.5	53.7
5	Located at 811 Lorneville Road	60.9	48.2
6	Located at 804 Lorneville Road	41.0	45.7
7	Located at the End of Lorneville Road	30.0	49.6

Project Facility Noise

With respect to Project facilities, the potential sources of noise include: vessel berthing and manoeuvring activities, fuel delivery activities (pumps, moving hoses, connecting valves, compressor stations, etc.), and general "port" activity (vehicles, people shouting, etc.). These noise sources will be restricted to the Canaport area.

On balance, there should be less noise, than currently experienced, due to Orimulsion® delivery activities based on the applicable *Occupational Health and Safety Act* standards. This standard requires shore-based equipment (various pumps and motors) to emit 85 dBA at 1 meter and 52 dBA at 50 meters. This standard and other noise attenuation measures (insulation baffles, buffering, etc.) will assure that Project facility noise will be in line with ambient levels.

5.7.6 Fire Protection Services

The Saint John metro area has eight fire stations with approximately 200 people employed full-time and 18 Holiday Relief Personnel who are employed casually, approximately 48-50 weeks a year. Each station provides rescue (including water and ice), environmental, and heavy industrial emergency service.

5.7.7 Police Protection Services

The Saint John police force currently provides policing services to the City. The department patrols an area from the Saint John airport in the east to Pocologan in the west, and northward to Grand Bay. The coverage area is comprised of four districts, east, west, north, and uptown central.

5.7.8 Coast Guard

CCG operations in the Bay of Fundy fall under the control of the Maritimes Regional Operations Centre (ROC) situated in Dartmouth Nova Scotia. This ROC is the focal point for initiating and coordinating responses related to non-Search and Rescue (SAR) related marine and fisheries incidents, for alerting response agencies of all incidents occurring within the ROC's area of responsibility. The Maritimes ROC includes ships, cutters, and helicopters, strategically placed throughout the region.

The CCG, in conjunction with Fisheries and Ocean's Marine Communications and Traffic Services (MCTS) program provides marine safety communications and marine traffic regulation services, such as providing traffic and waterway information and advice to vessels by way of VHF radio, and also collecting, analyzing and disseminating marine traffic information.

5.8 Proposed Development

Other proposed activities in the area includes waterfront development.

5.9 Heritage and Archaeological Resources

Heritage resources within the Study Area were identified based on the following:

- Accessing the Borden Site Map and Maritime Archaeological Research Inventory, (for archaeological sites), and review of a shipwreck database at Archaeological Services Unit (ASU) of the Heritage Branch of the Culture and Sport Secretariat;
- Examination of nautical charts (Saint John Harbor and Approaches, sheet 4117, 1:15,000);
- Review of Canadian Inventory of Heritage Structure, and a review of Provincially Designated Historic Sites file, at Heritage Branch of the Culture and Sport Secretariat;
- Review of Saint John Municipal Preservation Areas;
- Review of historical mapping for historical coastline and fortifications;
- Preliminary contact with ASU, the Heritage Branch, the New Brunswick Museum and the City of Saint John; and
- Review of other environmental assessments undertaken for the general area.

5.9.1 Cultural Description

The Study Area has several areas of long-term utilization, which have resulted in the recognition of a number of national, provincial and municipally registered heritage resources. There also exists a potential for unregistered resources. The goals of this research were to identify these resource locations. These categories encompass resources that are typically of concern to heritage regulators. Many non-designated heritage resources exist throughout the Saint John region and there is potential to encounter unknown or undiscovered archaeological/heritage resources.

Information on Aboriginal land use is drawn from registered archaeological sites, historic maps, and documents. Although it is possible that man first entered the Study Area during the latter stages of de-glaciation some 10,000 years ago, the artifactual evidence supports at least a 4,000-year occupation of the Saint John area.

More recent aboriginal sites, from 2,500 years before present to the time of contact between aboriginals and Europeans have also been recorded within the Study Area. The Saint John River system provided aboriginal peoples and early explorers/settlers with a travel route between coastal and interior New Brunswick and into Maine and Quebec.

Samuel de Champlain, to whom the credit is given for discovering Saint John, entered the harbour on Saint John the Baptist's Day June 24, 1604. It was to become a strategic location as a military post and trade centre. The availability and value of fur, fish, and later timber were also vitally important and soon recognized by traders such as Charles de La Tour and Charles d'Aulnay.

As the American Revolution came to an end, for Loyalists came to Nova Scotia and New Brunswick, including the Saint John area, and sanctuary. Loyalist influences, such as architecture and street layout, are still visible in some areas of Saint John.

During the eighteenth and early nineteenth centuries, early commercial activity was focused on fishing, but was displaced by timber and shipbuilding. During the shipbuilding era, Saint John was one of the world's leading shipbuilding centres.

Today the most common and most visible heritage resources are 19th and 20th century - structures and streetscapes. A number of these have been recognized by the city of Saint John in its Heritage Preservation Areas by law. Other heritage resources such as Martello Tower have been recognized by the Federal & Provincial governments.

It is important to note that sites of every occupation period may not be accurately or completely identified on historic maps, in documentary sources and by archaeological reports. Unidentified or unrecorded features, relating to known sites, may occur at some distance from features recorded on maps or plans. Similarly, plotted archaeological sites typically indicate the extent of testing or excavation, and not necessarily the full extent of the resource.

5.9.2 Municipal, Provincial, and Federally Designated Heritage Resources Within the Study Area

The following sections discuss of heritage resources in the Study Area including nationally, provincially, and municipally designated sites. Additional un-designated resources occur throughout the Study Area.

5.9.2.1 Provincially Registered Archaeological Sites

The Provincially registered archaeological sites within the Study Area are included in Table 5.12.

5.9.2.2 Municipally Designated Heritage Preservation Areas

To preserve the heritage character of specific areas of the city, the Saint John Heritage Preservation By-Law (City of Saint John 1995) limits certain types of development. Under the By-Law, the following activities are affected:

- the erecting, placing, relocating, removing, renovating, restoring, demolishing, altering, repairing or replacing of the exterior of a building or structure, in whole or part ...within Preservation Area...(1995:3).

These activities are defined as development and are subject to standards and a review process by the appointed Preservation Review Board of the City of Saint John. Table 5.12 includes Municipally designated heritage preservation areas within the Study Area.

TABLE 5.12 Archaeological/Heritage Resources

Constraint Map Identification Number	Description	Constraint Type
1	Saint John City Market City Market	- Designated National Historic Site 1986 - Designated Provincial Protected Historic Site (1980)
2	Carleton Martello Tower	- Designated National Historic Site, 1930 - Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
3	Partridge Island Battery Partridge Island Quratine Station	- Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000. - Designated National Historic Site, 1974
4	Fort Dufferin/Negro Point	- Provincially registered archaeological site (BhDm14) - Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
5	Navy Island	- Provincially registered archaeological site (BhDm9)
6	Lower Falls Site	- Provincially registered archaeological site (BhDm3)
7	Saint Rest Burial	- Provincially registered archaeological site (BhDm12)
8	Taylor's Island	- Provincially registered archaeological site (BhDm11)
9	Bentley Street Archaeological Site	- Designated Provincial Protected Historic Site (1998) - Provincially registered archaeological site (BhDm2)
10	Quinton Farmhouse	- Designated Municipal Heritage Preservation Area (1260 Manawagonish Road)
11	Fort Charnisay Fort(s) Frederick/D'Aulnay/Villebon/Boishebert	- Designated National Historic Site, 1923 - Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
12	Drummond Blockhouse	- Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
13	Marble Cove	- Provincially registered archaeological site (BhDm1)
14	Island Site	- Provincially registered archaeological site (BhDm4)
15	Prospect Point	- Provincially registered archaeological site (BhDm5)
16	Dennisons Point	- Provincially registered archaeological site (BhDm6)
17	Portland Point (Fort Latour)	- Designated Provincial Historic Site (1976) - Provincially designated archaeological site (BhDm7) - Designated National Historic Site 1923/89

TABLE 5.12 Archaeological/Heritage Resources

Constraint Map Identification Number	Description	Constraint Type
18	Melanson Site	• Provincially registered archaeological site (BhDm8)
19	Naval Reserve Division Site	• Provincially registered archaeological site (BhDm10)
20	Loyalist Burial Ground	• Provincially registered archaeological site (BhDm15)
21	Red Head Battery	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
22	Johnson Blockhouse	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
23	Chipman Hill Properties 1 Chipman Hill	• Designated Provincial Protected Historic Site (1980) • Designated National Historic Site, 1984
24	Calvin Church/Shaarei Zedek Synagogue; Saint John Jewish Community Center	• Provincially designated Historic Site (1994)
25	No. 2 Engine House Number 2 Mechanic's Volunteer Company Engine House	• Designated Provincial Protected Historic Site (1995) • Designated National Historic site, 1995
26	Church of Saint Andrew and Saint David	• Provincially designated Historic Site (2000)
27	Trinity Royal	• Municipally designated Heritage Preservation Area; Bordered by King, Water, Harding and Charlotte Streets and buildings facing King's Square and Queen's Square.
28	Orange Street	• Municipally designated Heritage Preservation Area; Orange Street and buildings facing Orange Street on Carmarthen, Wentworth and Pitt streets.
29	Douglas Avenue	• Municipally designated Heritage Preservation Area; Designated buildings on Douglas Ave. Alexandra Street, Bentley and Clarendon Streets.
30	Saint John County Courthouse	• Designated National Historic Site, 1974
31	Loyalist House	• Designated National Historic Site, 1958
32	Saint John Anglican Church/Stone Church	• Designated National Historic Site, 1989
33	Imperial Bi-Capital Theater	• Designated National Historic Site, 1985
34	Landing of the United Empire Loyalists in New Brunswick	• Designated National Historic Site, 1919
35	Prince William Streetscape	• Designated National Historic Site, 1981
36	Fort Howe	• Designated National Historic Site, 1954
37	Area of Aboriginal interest	• Located in the vicinity of the Musquash River.

TABLE 5.12 Archaeological/Heritage Resources

Constraint Map Identification Number	Description	Constraint Type
38	Area of Aboriginal interest	• Located in the vicinity of Seven Mile Lake (out of constraint mapping areas).
39	Area of Aboriginal interest	• Located in the vicinity of Spruce Lake.
40	Lower Cove Battery	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
41	Prince Edward Battery	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
42	Grave Yard Battery	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
43	Mortar Battery	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
44	Dorchester Blockhouse	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
45	Southeast Battery	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
46	Courtenay Bay Breakwater Battery	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
47	Fort Mispec	• Designated Provincial Historic Site (component of the Saint John Harbour Defensive Network), 2000.
48-53	Elevated Potential Areas	• Areas of elevated potential for archaeological resources. Based on presence of existing sites, transportation routes, and environmental characteristics commonly associated with heritage resources in the region.

5.9.2.3 Provincially Designated Historic Sites

A number of sites within the Study Area are designated under Provincial Heritage Legislation and are included in Table 5.12.

5.9.2.4 Nationally Designated Historic Sites

The Historic Sites and Monuments Board of Parks Canada recognizes nationally significant sites, persons, events and other aspects of Canada's history, and has made over 1000 designations Canada wide since 1919. Site-specific National Historic Sites designated in the Study Area are included in Table 5.12.

5.9.2.5 Heritage Structures

To date, approximately six thousand structures within the City of Saint John have been recorded under various heritage inventories, including the Canadian Inventory of Historic Building. These buildings are not currently protected under present legislation. Due to very high probability that heritage structures will not be impacted by the pipeline, and the number and density, this resource has been omitted from Table 5.12.

5.9.2.6 Areas of Elevated Potential for Archaeological Resources.

A review of 1:50,000 topographical mapping and environmental features has been undertaken for preliminary predictive modelling purposes. Six areas of elevated potential for heritage resources overlap the Project Footprint at the following locations:

Red Head Mountain Elevated Potential Area – (Approximately 1 km in length)

This area is located on the slope and summit of Red Head Mountain, and was identified as exhibiting elevated potential for the recovery of archaeological resources associated with a vantage point. Red Head Mountain is the highest point in the area and provides a good vantage over the coastline. There is potential to encounter historic and pre-contact resources.

Canaport Elevated Potential Area – (Approximately 2 km in length)

This area encompasses the coastline of the Mispec Bay-Mispec Point-Anthony's Cove Area. The Preferred Route begins at Canaport within this area of elevated potential. Area identified as exhibiting an elevated potential for the recovery of historic and pre-contact resources associated with the coastline.

Red Head Marsh Wetland – (Approximately 2 km in length)

The RoW borders the eastern edge of Red Head Marsh. The area was identified as exhibiting elevated potential for archaeological resources associated with resource procurement.

Bayside Drive to Simms Corner – (Approximately 11 km in length)

The Project Footprint from Bayside Drive to Simms Corner was identified as exhibiting elevated potential for archaeological resources based on presence of known resources within the general area, and the potential for additional resources associated with pre-contact and historic settlement in the City of Saint John.

Saints Rest Marsh/Lorneville Harbour – (Approximately 3 km in length)

The Project Footprint borders the northern boundary of the Saints Rest Marsh. This area was identified as exhibiting elevated potential due to the presence of existing heritage and archaeological resources, in addition to the potential for resource procurement associated with Saints Rest Marsh.

Coleson Cove – (Approximately 1 km in length)

This area extends from the coastline at the CCGS site to approximately 1 km inland. The area around Coleson Cove was identified as exhibiting elevated potential for the recovery of archaeological resources due to proximity to coastline resources.

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6.0 VALUED ENVIRONMENTAL COMPONENTS

The assessment focuses on the evaluation of potential interactions between Project components and activities, and ECCs that were identified through an issues-scoping process. Each is examined and organized to identify the priority matters for further environmental assessment.

6.1 Environmental Components of Concern

Issues and concerns have been identified by regulators through the registration review process, by resource managers through consultation, by experts retained to conduct the studies or otherwise consulted on the Project, by stakeholders who have been briefed and made aware of the Project plans, and by the general public who have been invited to review the Project description information and provide comments on issues and concerns.

The identified issues and concerns have been organized into ECCs and listed in Table 6.1, which indicates the source or sources which identified the item. In many cases, the issue can be attributed to several sources.

6.2 Pathway Analysis

The identified ECCs have been considered with respect to the Project to determine whether there is a possible interaction with the Project and, if so, what the nature of interaction would be. At this stage, the consideration asks the question: is there likely to be a pathway (or link)? Only those ECCs which can be linked to the Project are carried forward for further examination.

The examination of the list of ECCs also takes into account the Project Design as presented in Section 4.0 (Project Description) and considers whether there remains a potential effect such that the ECC needs to be incorporated into the VEC identification and further examined and assessed.

The interaction matrix shows that most of the ECCs have a logical link to one or more aspects of the Project. However, the loading facility is not now planned to be Pier 10, hence two ECCs (shown with "*"in Table 6.2) no longer apply.

In addition, the development of the Project Description has addressed and resolved a number of issues (indicated with "**" in Table 6.2), *i.e.*, Project Design has avoided the following interactions:

- The capacity of the Spruce Lake reservoir to supply water to the facility during operations has been confirmed. JWEL (2002), summarized data from the City of Saint John, which indicates that current water demands from Spruce Lake system are approximately 47,520 m^3/day. The historical (1973 – 1983) demand of approximately 81,216 m^3/day was supplied without problem. Therefore, it is clear that even with the incremental change of 4,320 m^3/day required for the Project the predicted demand is much less than the historic demand. This indicates that adequate supply is not a concern.

- Potential effects of new pipeline construction and operation on neighbouring properties has been considered in route selection and design.
- The integrity of the existing pipeline has been confirmed through an inspection and expert evaluation.

TABLE 6.1 The Environmental Components of Concern

Issue/concern	Regulator[1]	Expert[2]	Prop.[3]	Res. Mgr[4]	Stakeholder[5]
Sustainability – (The capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of the present and those of the future)	X	X	X		
Cumulative Environmental Effects	X				
Air quality from Plant emissions.	X	X	X	X	X
Maintenance of human health for community residents	X	X	X		X
Production of CO$_2$ and other greenhouse gases	X		X		X
Spills of Orimulsion®:					
in the Bay of Fundy	X	X	X	X	X
along the pipeline route or from storage tanks	X				X
Migratory Birds	X			X	
Surface water quality	X			X	
Groundwater quality	X				
Spruce Lake freshwater supply	X		X	X	X
Vehicle traffic – noise, safety, spills, air quality/emissions, congestion	X				X
Visual effect, including cruise ship trade from presence of fuel storage tanks at Pier 10	X				X
Employment and Economic benefits and costs	X		X		X
Effects of fuel storage tank at Pier 10 on future Port development	X				
Worker health and safety	X		X		
Archaeological resources	X				
Terrestrial and wetland disturbance	X			X	X
Adjacent properties to new pipelines	X				
Saints Rest Marsh	X			X	X
Effects of Environment on the CCGS	X		X		X
Facility Lifespan	X				
Probability of Spills	X	X			X
Shoreline Erosion near the CCGS	X				
2001 Province of New Brunswick – Energy Policy	X		X		
Existing Pipeline integrity	X		X	X	X

Notes:
1. Regulator – Regulatory Authorities (federal, provincial, municipal)
2. Expert – individuals having relevant baseline data, information knowledge or expertise
3. Proponent – NB Power
4. Resource manager – a non-regulatory authority controlling activities of a particular resource
5. Stakeholders – members of non-government organizations, general public, etc.

TABLE 6.2 ECC - Project Interaction

Issue	Design	Construction	Operation & Maintenance	Decommissioning	Contingency
Sustainability		X	X	X	
Cumulative Environmental Effects***	X	X	X	X	X
Air quality from Plant emissions.			X		X
Maintenance of human health for community residents.			X		X
Production of CO_2 and other greenhouse gases		X	X		
Spills of Orimulsion® in the Bay of Fundy along the pipeline route or from storage tanks					X X
Migratory Birds		X			X
Surface water quality		X	X	X	X
Groundwater quality		X	X	X	X
Spruce Lake freshwater supply **			X		
Vehicle traffic – noise, safety, spills, air quality/emissions, congestion		X	X		X
Visual effect, including cruise ship trade from presence of fuel storage tanks at Pier 10*					
Expenditure and employment levels		X	X		
Effects of fuel storage tank at Pier 10 on future Port development*					
Worker health and safety		X	X		
Archaeological resources		X			
Terrestrial and wetland disturbance		X	X		X
Adjacent properties to new pipelines**		X	X		X
Saints Rest Marsh		X	X		X
Effects of the Environment on the CCGS			X	X	
CCGS lifespan			X	X	
Probability of spills					X
Shoreline erosion near the CCGS			X	X	
2001 Province of New Brunswick – Energy Policy			X		
Existing Pipeline integrity **			X		

Notes:
- * ECC specific to Pier 10, therefore, no longer applies.
- ** Issues investigated and resolved.
- *** Effects were assessed for each VEC.

The concerns with respect to Cumulative Effects are to be addressed as an ingredient of the effects assessment of each VEC, hence this item (shown with "***" in Table 6.2) is addressed throughout the assessment.

The remaining ECCs are listed in Table 6.3. The potential interactions between the Project and the ECCs are described below. The major interactions relate to Project operation and to unplanned events:

- Sustainability Assurance relates to addressing the needs of the present without compromising future generations, and applies to construction, operation, and decommissioning phases of the Project.
- Air Quality relates to the changes from the existing CCGS operation with respect to the nature and quantity of emissions, and their pattern of deposition. Any changes in the characteristics of upset events with respect to airborne emissions are also relevant.
- Community human health relates to the potential for changes in emissions within the airshed of the CCGS during operations or as a consequence of contingency events, to produce a change in human health risk to the area residents.
- Spills of Orimulsion® relates to the relative probability and consequences of a contingency event associated with transport, transfer and storage of this fuel versus Fuel Oil #6.
- Migratory birds may be affected by the Project as a consequence of a contingency, *i.e.*, an Orimulsion® Spill, or habitat alterations from Pipeline or SWSDA construction.
- Surface water quality can be affected by drainage from the SWSDA adjacent to the CCGS site, during operation and following closure of the facility.
- Groundwater quality can be affected by drainage from the SWSDA facility adjacent to the CCGS site, during operation and following closure of the facility.
- Vehicle traffic can affect noise, air quality and congestion as a consequence of increased levels during CCGS refurbishment construction, and slightly increased levels during CCGS operation.
- Expenditures and employment levels will increase during Project construction; a small increase in employment levels will occur during operation. These changes can improve living standard.
- Worker health and safety exposures could change during construction and, to a lesser extent, during operations.
- Archaeological resources could be affected by new pipeline construction in areas lacking in recent disturbance phenomena.
- Terrestrial wetland and freshwater areas along the potential new pipeline sections could be affected by pipeline construction, operations maintenance and contingency events (leaks, spills). Any changes in operations maintenance activities could affect areas along the existing pipeline sections, (*e.g.*, Saints Rest Marsh).
- The environment (climate change) could affect the CCGS operations, closure and contingency phases through water level changes in the marine environment.

TABLE 6.3 Environmental Components of Concern to be Assessed

Environmental Component of Concern	Design	Construction	Operation & Maintenance	Decommissioning	Contingency
Sustainability		X	X	X	
Air quality from Plant emissions.			X		X
Maintenance of Human Health for community residents.			X		X
Production of CO_2 and other greenhouse gases		X	X		
Spills of Orimulsion® in the Bay of Fundy, along the pipeline route or from storage tanks					X X
Migratory Birds					X
Surface water quality			X	X	X
Groundwater quality		X	X	X	X
Vehicle traffic – noise, safety, spills, air quality/emissions, congestion		X	X		
Expenditures and employment levels		X	X		
Worker health and safety		X	X		
Archaeological resources		X			
Terrestrial wetland and freshwater areas disturbance		X	X		X
Adjacent properties to new pipelines**		X	X		X
Effects of the Environment on the CCGS					
CCGS lifespan			X	X	
Probability of spills					X
Shoreline erosion near CCGS			X	X	X
2001 Province of New Brunswick – Energy Policy compliance	X				

** Issues investigated and resolved.

6.3 Selection of Valued Environmental Components

This listing of priority ECCs forms the basis for the identification of the VECs and their associated indicators. The selected VECs have been organized into logical groupings, as shown in Table 6.4.

6.3.1 VEC Descriptions

The following is a summary of the rationale for VEC selection. VECs are presented in order of discussion in the EA, but are not ranked by importance. Pathway VECs are presented before related VECs so that any changes to a pathway VEC are discussed prior to any discussion regarding the effects of these changes on another VEC. For each VEC, the description includes the definition of boundaries – geographic extent, duration and magnitude.

TABLE 6.4 Project Valued Environmental Components

V EC	Scope	Indicators
Air Quality	Plant and traffic emissions, during operation and maintenance. Plant upset conditions Start-up / shutdown Traffic emissions during construction.	SO_2 NOx Particulate, fine particulate (PM_{10}), respirable particulate ($PM_{2.5}$ metals (including vanadium and nickel) CO_2 and greenhouse gases
Marine Ecosystem	Potential Spills of Orimulsion® in the Bay of Fundy.	CERA Species/populations of concern (including Migratory/marine Birds) Habitats
Terrestrial and Freshwater Ecosystem	Disturbance effects during construction for new pipeline sections. Disturbance effects during operations and maintenance from new and existing pipelines. Surface water quality near the SWSDA Site during operations. Groundwater quality adjacent to the SWSDA site during construction, operations, decommissioning. Water quality and habitat disruption at water body crossings during construction of new pipeline sections, and during operation and maintenance of new and existing pipelines.	Terrestrial habitat units Wetland and freshwater habitat units Surface Water quality at the SWSDA discharge location. Groundwater quality at SWSDA monitoring wells. Habitat survey results at water crossing locations.
Human Health and Safety	Community Health effects during operation and maintenance from airborne and deposited substances. Safety, congestion, noise effects on community from traffic during construction and operation and maintenance. Worker health and safety during construction and operations. Plant upset conditions Start-up / shutdown	Relative change in pathways, exposure levels for selected contaminants. Highway design standards Ambient/historical traffic levels Existing standards and performance levels
Economy and Culture	Economic and employment changes during construction and operations. Archaeological resources at risk during pipeline construction and solid waste site	Construction Capital expenditures; Incremental person/years of employment during construction, operation Archaeological potential of new pipeline sections
Sustainability Assurance	Rare and endangered species/communities affected by construction or operations. Production of CO_2 and other greenhouse gases 2001 Province of New Brunswick – Energy Policy compliance	Rare and endangered species/communities surveys. Air quality modelling NB Power Energy policy comparison
Environment on the CCGS	Facility operations lifespan Change in probability of spills Shoreline erosion effects on facility operation	Calculated storm surge elevation at plant site

Pathway VEC

Air Quality provides a link between the Project and receptors. Thus, Air Quality is a pathway for contaminants, and the major concern is with respect to the effects which these contaminants can have on the biological and human environment, the plant, animals, and humans who can be affected by the presence of contaminants in the food chain.

The Air Quality VEC is important for the health and safety of people living and working near the Project site, as well as to local wildlife and vegetation. The Project, during operations, will result in a reduction to the deposition pattern and in the total quantity of airborne emissions due to the conversion from Fuel Oil #6 to Orimulsion®, and due to changes in emissions control systems. During construction and, to a much lesser extent during operations, there will be increases in vehicle traffic to and from the Project site. The overall reduction in air emissions from the Project will improve overall ambient air quality in the airshed of the CCGS.

Air quality and local climate conditions are important to overall ecosystem health and to other VECs. Air emissions are regulated federally and provincially.

Biophysical VECs

The marine ecosystem of the Bay of Fundy is important for fishing and aquaculture, marine transportation, recreation and tourism. During operations, tankers will transport Orimulsion® to a port facility in the Bay of Fundy. Tanker traffic, as a result of the Project, will be reduced from present frequencies. Orimulsion® has different chemical, physical and toxicological characteristics from Fuel Oil #6, so that a spill event would likely affect the marine ecosystem in a manner different from Fuel Oil #6. The marine environment is regulated federally and provincially.

The terrestrial and freshwater ecosystem features of the area, which encompasses the CCGS site and pipeline route, include areas of high usage, and open less disturbed regions with important natural features. Freshwater is valued since it is important as a source of drinking water, as well as habitat for fish, wildlife, and vegetation. During Project construction, some terrain disturbance will occur in association with the pipeline route where new sections of pipe will need to be constructed. During operations and maintenance of the pipeline system, continuing interaction is likely with the adjacent natural features along the RoW. The small watershed adjacent to the SWSDA site includes productive fish habitat. Surface and groundwater can act as transport mechanisms whereby contaminants can enter freshwater ecosystems from the operation and decommissioning of the SWSDA. During pipeline construction, some water bodies will have to be crossed. During CCGS operation, there will be an increased requirement to extract water from the existing municipal water supply watershed. Terrestrial and wetland ecosystems are regulated provincially. Freshwater aquatic ecosystems are regulated federally and provincially. The water supply is administered by the Saint John Municipality.

Socio-Economic VECs

Human health and safety is valued since people are naturally adverse to activities which can compromise their health, longevity, or quality of life. The Project will interact with the surrounding community through the changed pattern of air emissions, during operations, and through the noise and congestion associated with vehicular traffic during construction and operations. During construction and operation, Project workers will be subject to workplace hazards and risks, which can affect their health and safety.

Economic and cultural components of the socio-economic environment are important to people in terms of standard of living, lifestyle and sense of community. The expenditures for employment and purchases of goods and services are valued by individuals who may derive direct or indirect revenue from the Project during construction and operation. Employment and business are regulated by the provincial and federal governments. Historic resources are important because of the information they reveal about past and contemporary ways of life, cultural identity, and relationships and interactions with other cultures and the biophysical environment as well as having the potential to become economically viable tourist attractions. Archaeological resources that predate European contact are particularly important for aboriginal peoples because information that can be retrieved from sites and artifacts represents the physical archives of their past. Project construction could result in the loss or alteration of historic resources. Historic resources in the province are protected under provincial legislation.

Sustainability Assurance

The definition of sustainable development from the CEAA is "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs."

Sustainability assurance can be achieved, in part, through the protection of biological diversity, or biodiversity. This term refers to the total variety of all living things in a particular area or region. Biodiversity is defined as "...the variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems" (Environment Canada 1995). This includes genetic diversity, diversity among species, and diversity among the communities and ecosystems in which they occur. For the purpose of this assessment, biodiversity is considered at the species and ecosystem (habitat) levels.

Neither sustainability nor biodiversity are isolated concepts, but a part of Project planning (mitigations and monitoring), environmental effects analysis, and consideration of sustainability. NB Power has applied this concept in carrying out scoping, effects analysis, Project design and mitigation, determination of effects significance, and monitoring. This concept is integrated both implicitly and explicitly throughout this EA.

Effect of the Environment on the Project

The potential for climate change could affect the design assumptions associated with the Project. Current thinking on climate change indicates that there is likely to be small variations in temperature, more extreme weather, and a small rise in sea level over the next 25 years. This change could result in an increase in the height of storm surges, which could potentially damage the CCGS.

The effect of a specific project activity on a VEC may differ in both space and time from the effect of any other activity. Certain project activities may have long-term consequences; others will be of short duration. Therefore, an important aspect of the EA process is the determination of study boundaries. Temporal and spatial study boundaries have been considered for the pre-construction/construction, operation, decommissioning and abandonment phases of the Project.

The spatial boundaries for construction include the actual footprint of the CCGS, as well as any new pipeline and storage tank construction to be completed between the station and the shipping terminal. The boundaries encompass those VECs, which the assessment has determined, are potentially affected. Spatial boundaries are identified for each VEC. Specific considerations were also given to the geographic ranges of particular identified VECs. Temporal Project boundaries for this phase are estimated to extend over a three-year period.

The operation phase also includes similar spatial boundaries as the construction phase. For the operation phase, the temporal boundaries extend for at least 25 years subsequent to completion of construction.

The spatial boundaries for decommissioning are expected to be similar to construction phase boundaries. The temporal boundaries for decommissioning extend for about three years to allow the effectiveness of restoration activities to be monitored and to conduct any required maintenance.

The prediction of environmental effects has considered, however, longer durations for those effects on VECs that could result in longer-term effects for all Project phases.

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7.0 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Approach

The Environmental Effects prediction has been organized by VECs, with each section following a consistent pattern as outlined in Table 7.1. This approach is consistent with methods provided by the CEAA. The Terms of Reference for this EA point out the essential issues to be addressed in regard to prediction of impacts to VECs associated with a proposed project can be expressed as three fundamental questions:

- Will the identified impacts be positive or negative?
- Will the identified impacts be significant?
- What is the likelihood of significant negative impacts occurring?

The first question posed is important, especially for an undertaking which is essentially an environmental mitigation by its nature (*i.e.*, reduction in airborne emissions). For this reason, many of the technical studies called for in the Guidelines have been comparative evaluations, *i.e.*, intended to establish the differences caused by the Project when compared with the existing situation.

In the consideration of each VEC (and the associated indicators), it will be important, early in the analysis to consider whether the identified impacts will be positive or negative. If the impacts are clearly positive, then further evaluation (significance, likelihood, cumulative effects, sustainability) is not required. As lead-in to the Potential Environmental Effects Analysis for each VEC, this question will first be posed. If the evidence from the detailed evaluation supports the prediction of a positive environmental effect, no further analysis or prediction is presented.

7.1.1 Overview of Studies

In support of the EA, a series of Technical Reports have been issued separately to government, stakeholders and are available to the public. This important reference material provides the basis for much of the analysis presented in this section. Material which is directly relevant to the effects prediction has been extracted or summarized in the EA. For ease of reference, Table 7.2 provides a summary description of the scope of each of the Technical reports, and the relationship to the Environmental Effects Assessment presented in this section.

TABLE 7.1 General Outline of VEC Sections

Section (VEC Title)	Contents Introduction
SCOPE OF THE ASSESSMENT	
Environmental Assessment Boundaries	Description of environmental assessment spatial and temporal boundaries reflecting Project, ecological and/or socio-economic boundaries where relevant
Administrative Boundaries	Description of management jurisdictions (provincial, federal, municipal) and/or relevant legislation
Technical Boundaries	Description of any substantive constraints on baseline collection/presentation or environmental effects predictions
Baseline	Explanation of sources of information and/or overall statement of existing conditions
Likely Future Conditions	Discussion of likely condition of environment within expected lifespan of Project
POTENTIAL EFFECTS ANALYSIS	
Methods	Description of analysis/prediction methods
(sub-sections)	Presentation of environmental effects
Cumulative Environmental Effects	Discussion of cumulative environmental effects
MITIGATION	
Environmental Mitigation and Optimization	Design, summary of environmental management initiatives
RESIDUAL ENVIRONMENTAL EFFECTS	
(sub-sections)	Residual environmental effects significance by Project phase

TABLE 7.2 Description of Scope of Component Studies

Component Studies	VEC	Linkage
Air Quality	Air Quality	• Plant and traffic emissions, during operation. • Traffic emissions during construction.
Bay of Fundy CERA	Marine Ecosystem	• Spills of Orimulsion® or Fuel Oil #6 in the Bay of Fundy.
Transportation	Human Health and Safety	• Safety, congestion, noise effects on community from traffic during construction and operation. • Worker health and safety during construction and operations.
Socio-economic	Economy and Culture	• Economic and employment changes during construction and operations.
Human Health Risk Assessment	Human Health and Safety	• Community Health effects during operation from airborne and deposited substances.
Fuel Delivery	Terrestrial and Freshwater Ecosystem	• Water quality and habitat disruption at water body crossings during construction of new pipeline sections, and during operation and maintenance of new and existing pipelines. • Disturbance effects during construction, operation and maintenance of new and existing pipelines. • Spills of Orimulsion® along the pipeline route, or from storage tanks.
	Economy and Culture	• Archaeological resources at risk during Pipeline Construction. • Rare and endangered species/communities affected by construction or operations. • Habitat survey results at water crossing locations if required.
Environmental Background (SWSDA)	Terrestrial and Freshwater Ecosystem	• Surface water quality near the SWSDA during Operations. • Groundwater quality adjacent to the SWSDA during construction, operations, decommissioning.
Surface Water Supply	Terrestrial and Freshwater Ecosystem	• The capacity of the Spruce Lake reservoir.

7.2 Air Quality

7.2.1 Scope of the Assessment

7.2.1.1 Assessment Boundaries

The environmental assessment boundary for the air quality studies was formed by a square grid of 40 km per side, with the CCGS at its centre. This spatial boundary is defined by the air quality modelling used. In addition, air quality dispersion models become less reliable as one moves further from the source due to changing terrain, variable micro-climate conditions, as well as the nature of the statistics involved in the mathematical models. The only major urban area within the grid is Greater Saint John, the centre of which lies approximately 15 km northeast of the plant. The Bay of Fundy lies to the east through the southwest of the generating station, while the balance of the grid is rural in nature, as depicted in Figure 7.1.

In terms of administrative boundaries, the Province of New Brunswick, through its Department of Environment and Local Government is the lead authority. The ambient Air Quality Standards for New Brunswick are shown in Table 7.3. Nonetheless, the *Canadian Environmental Protection Act* does provide the Federal Government with some scope for jurisdiction, particularly in terms of trans-boundary impacts.

There are presently in existence Federal/Provincial Agreements which define and limit total SO_2 emissions in New Brunswick. This agreement is bolstered by a similar agreement signed by the Conference of NEG/ECP, which anticipates significant reductions in regional SO_2 emissions by 2010. In addition, the NEG/ECP's decisions on air emissions deal with targets for the emissions of NOx, such that NB Power's total NOx emissions could be curtailed by 30% by 2007. The CCGS, as NB Power's largest generating facility can play a significant role in achieving such a reduction.

7.2.1.2 Baseline

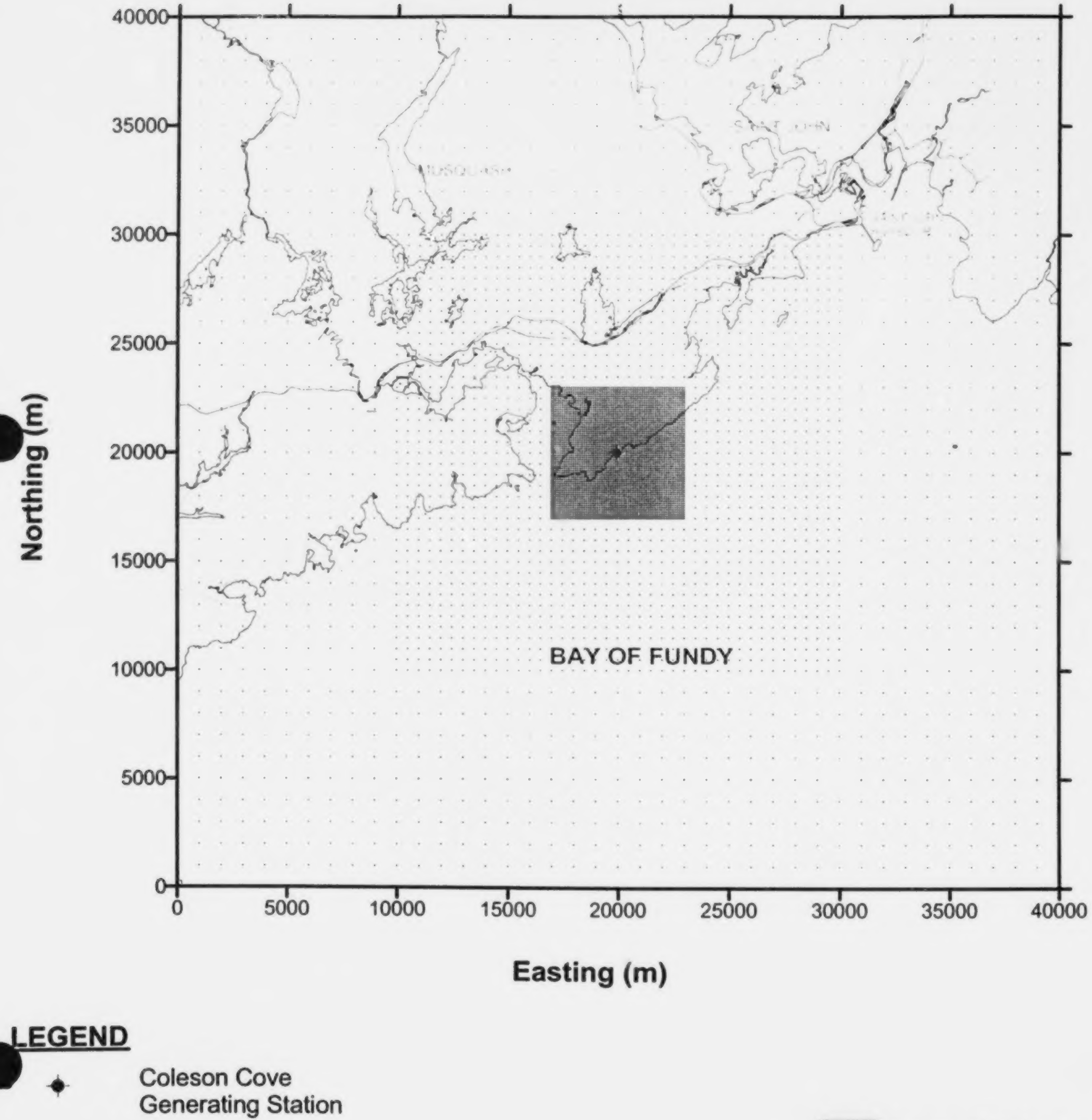
Meteorology

Although New Brunswick is a coastal province, its climate is continental in nature, with the Bay of Fundy region's temperatures moderated by the combined continental and maritime influences. Thus, coastal areas such as Saint John experience moist Atlantic air most of the year, producing mild periods in the winter and relatively cool weather for the remainder of the year.

As air moves over the Bay of Fundy, it is often cooled, and as a result, the flow becomes stable and the vertical motions are suppressed somewhat in the cold bottom layer. This stability can greatly influence the dispersion of an exhaust plume such as the one from the CCGS which is located on the coast, and will also effect mixing heights. This stability characteristic has been incorporated in the modelling of the plume from the generating station.

Figure 7.1 - Receptor Plan

NB Power
Coleson Cove Generating Station
Lorneville, New Brunswick



40000
35000
30000
25000
20000
15000
10000
5000
0
Northing (m)
0
5000
10000
15000
20000
25000
30000
35000
40000
Easting (m)
SAINT JOHN
MUSQUASH
BAY OF FUNDY
LEGEND
Coleson Cove Generating Station

Jacques Whitford Environment Limited

TABLE 7.3 Canadian and New Brunswick Ambient Air Quality Objectives

Contaminant	Period of Time	New Brunswick Maximum Permissible Ground Level Concentration for Acceptable Air Quality[1] ($\mu g/m^3$)	National Ambient Air Quality Objectives, Maximum Desirable/Acceptable Levels[2] ($\mu g/m^3$)	Maximum Permissible Ground Level Concentration for Areas Including Saint John County[3] ($\mu g/m^3$)
SO_2	1-hr	900	450 / 900	450
	24-hr	300	150 / 300	150
	Annual	60	30 / 60	30
NOx (As NO_2)	1-hr	400	- / 400	400
	24-hr	200	- / -	200
	Annual	100	60 / 100	100
Total Suspended Particulate Matter	24-hr	120	- / 120	120
	Annual	70	60 / 70	70
PM_{10}	24-hr [4,5]	NA	50	N/A
	Annual[5]		30	
$PM_{2.5}$	24 hr [6]	NA	30	N/A

Notes:

1. *Clean Air Act* for New Brunswick (1997) Air Quality Regulation, Schedule B – Maximum Permissible Ground Level Concentrations in Micrograms per Cubic Metre at Standard Conditions.
2. Canadian Environmental Protection Act, Clean Air Act, Ambient Air Quality Objectives Order, No. 1, Schedule 1.
3. *Clean Air Act* for New Brunswick (1997) Air Quality Regulation, Schedule C – Maximum Permissible Ground Level Concentrations of Sulphur Dioxide in the Counties of Charlotte, Kings and Saint John in Micrograms per Cubic Metre at Standard Conditions.
4. Greater Vancouver Regional District (GVRD) (2001) '2000 Lower Fraser Valley Ambient Air Quality Report', Acceptable Objectives, September 2001.
5. CCME (1998) Canada Wide Accord on Environmental Harmonization of the CCME and Canada Wide Environmental Standards Sub-Agreement (optional values), 1998.
6. CCME (2000) Canada Wide Standards for Particulate Matter (PM) and Ozone, June, 2000.

N/A = Not Applicable

The topography in southern New Brunswick is characterized by hills sloping down to tidal marshes on the Bay of Fundy as shown in Figure 7.2. Topography has little effect on the climate of this region, except where there are local effects and an influence on the direction of air motion near the ground surface.

The monthly climate norms of temperature, relative humidity, and precipitation are presented for illustration, in summary form, for measurements made at the Saint John Airport (Table 7.4).

The weather data required to assess the potential effects of both the existing and proposed CCGS in terms of dispersion modelling includes hourly measurements of wind velocities and direction, and temperature. Additional requirements for atmospheric stability, and mixing layer depth are met by calculations from the aforementioned measurements as well as from other data including cloud cover, snow cover and solar radiation. Given the height of the plume release and plume rise, both surface meteorological data and upper air data are necessary to conduct the assessment. Based on consultation with the local Federal climatologist, it was determined to use surface data from the Saint John Airport station, and upper air data from the Yarmouth, Nova Scotia station (the nearest upper air station), as is typically done for other air quality studies in Southern New Brunswick.

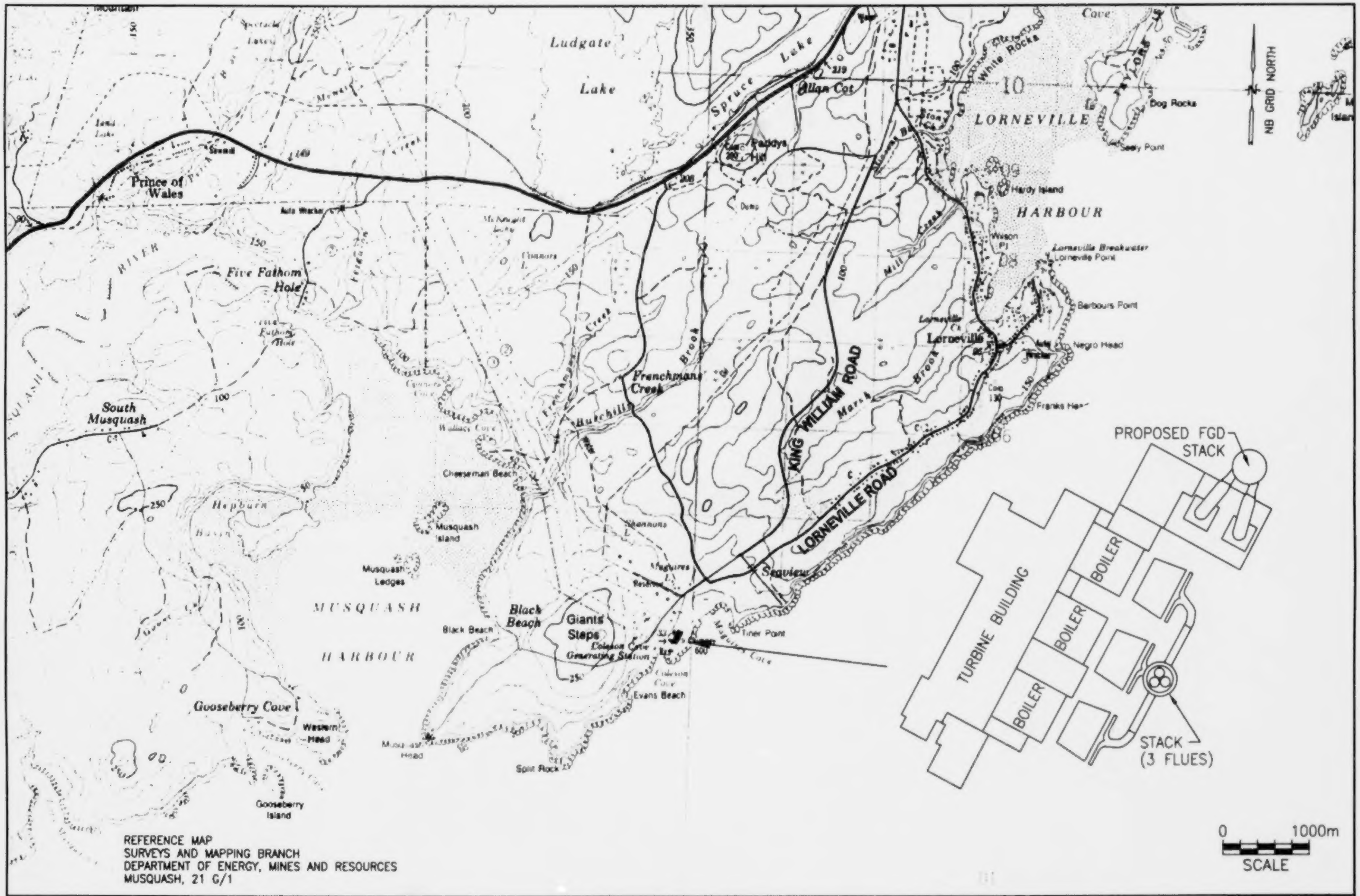
Six years of quality assured meteorological data (Jan. 1995 – Dec. 2000) were obtained from the Atmospheric Environment Service, including hourly data from Saint John, and twice-daily upper air data from Yarmouth. The US Environmental Protection Agency PCRAMMET meteorological pre-processor was used to merge surface data with upper air data, thus enabling the calculation of stability parameters and mixing heights. The stability of the atmosphere is an indicator of the amount of vertical motion occurring, with mixing and dispersion (dilution) increasing with instability. Warm, sunny days with light winds are less stable than those periods when the earth's surface is cooler than the air above it, such as clear, cool nights. A stable atmosphere generally exists with a temperature inversion at a particular height above grade.

The atmospheric stability is considered neutral when there is little to no heating or cooling of the ground and the air adjacent to it. This neutral stability is characterised by cloudy conditions which inhibit solar radiation, windy conditions which would cause rapid vertical mixing, or a transition near sunrise or sunset when the atmosphere is changing from unstable to stable or vice versa.

The average annual wind direction frequency distribution for the Saint John area is indicated in Figure 7.3. The wind direction is reported as the direction from which the wind blows, and is measured at a height of 10 m above grade. The dominant winds are from the south and southwesterly quadrants, with the northwesterly direction also being important, although not as dominant.

Very low wind speeds occur most often from the eastern quadrant, while strong winds occur most often from the southwest sector

FILE: SITE


Ludgate Lake
Spruce Lake
Allan Cot
Paddys Hill
Prince of Wales
Five Fathom Hole
River
South Musquash
Hepburn Basin
Gooseberry Cove
Western Head
Gooseberry Island
Musquash Harbour
Musquash Ledges
Musquash Island
Cheeseman Beach
Black Beach
Giants Steps
Coleson Cove Generating Station
Coleson Cove
Evans Beach
Split Rock
Tiner Point
Seaview
Frenchmans Creek
Hutchills
KING WILLIAM ROAD
LORNEVILLE ROAD
Lorneville
Lorneville Harbour
Hardy Island
Lorneville Breakwater
Lorneville Point
Barbours Point
Negro Head
Franks Head
White Rocks
Dog Rocks
Seely Point
Mill Creek
Marsh Brook
NB GRID NORTH
PROPOSED FGD STACK
TURBINE BUILDING
BOILER
BOILER
BOILER
STACK (3 FLUES)
0
1000m
SCALE

REFERENCE MAP
SURVEYS AND MAPPING BRANCH
DEPARTMENT OF ENERGY, MINES AND RESOURCES
MUSQUASH, 21 G/1

SITE PLAN
NB POWER, COLESON COVE
LORNEVILLE, NB

Date: 2002 05 01	Scale: 1 : 60 000
Job No.: 13269	Fig. No.: 7.2

Jacques Whitford
Consulting Engineers
Environmental Scientists

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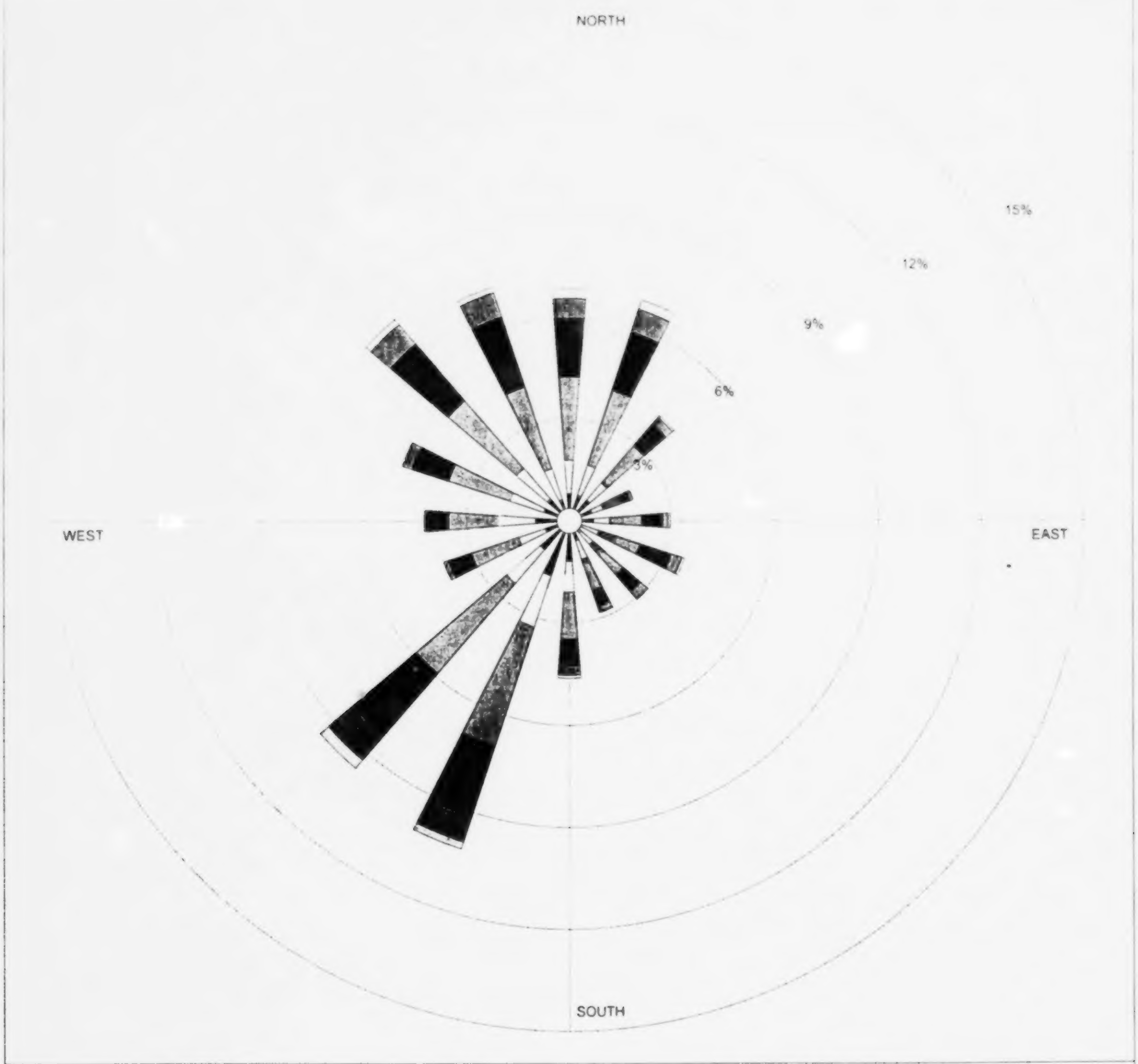
TABLE 7.4 Monthly Climate Normals[1] – 1946-1990 - Saint John Airport – Lat 45°20'N Long 65°53'W - Elevation: 103 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Period of Record (Years)
T extreme max (C)	14.0	11.1	15.8	22.8	30.0	32.0	32.8	34.4	28.9	25.6	21.7	16.1	-	44
T mean max (C)	-2.8	-2.3	2.1	7.9	14.4	19.2	22.1	21.8	17.6	12.1	6.0	-0.2	9.8	44
T mean min (C)	-13.6	-13.3	-7.5	-1.5	3.7	8.4	11.6	11.5	7.6	2.9	-1.9	-9.9	-0.2	30
T extreme min (C)	-31.7	-36.7	-30.0	-16.7	-7.8	-2.2	1.1	-0.6	-6.7	-10.6	-16.7	-34.4	-	30
Mean Relative Humidity at 0600L (%)[2]	77	77	80	84	87	90	92	93	92	88	85	81	-	30
Mean Relative Humidity at 1500L (%)[2]	68	65	64	61	61	64	67	66	65	66	71	72	-	30
Mean Precip (mm)	128.3	102.6	109.9	109.7	123.1	104.8	103.7	103.0	111.3	122.5	146.2	167.6	1432.8	30
Mean Snow Fall (cm)	71.7	56.5	47.6	23.1	2.2	0.0	0.0	0.0	0.0	2.4	15.1	64.4	283.2	30
Mean # days with Precip >= 0.2 mm	16	13	14	14	14	13	12	12	11	12	15	17	164	30

Notes 1. Environment Canada - Canadian Climate Normals (1993)
2. Relative Humidity measured at 0600L (6:00 am local time) and 1500L (3:00 pm local time)

WIND ROSE PLOT

NB Power - Coleson Cove, Lorneville, New Brunswick **Job No. 13269-0001**



Wind Speed (m/s) > 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	MODELER **JWEL**	DATE **9/17/01**	COMPANY NAME **Jacques Whitford Environment Ltd.**
	DISPLAY **Wind Speed**	UNIT **m/s**	COMMENTS **Meteorological Data** **Saint John, NB** **1995-2000**
	AVG. WIND SPEED **4.73 m/s**	CALM WINDS **15.32%**	
	ORIENTATION **Direction** **(blowing from)**	PLOT YEAR-DATE-TIME **1995** **Jan 1 - Dec 31** **Midnight - 11 PM**	PROJECT/PLOT NO **Figure 7.3**

WRPLOT View 3.05 by Lakes Environmental Software - www.lakes-environmental.com

Ambient Air Quality

NBDELG has been monitoring ambient air quality in the Saint John area since 1961. The number of monitoring sites, as well as the actual numbers of monitors and pollutants measured has increased over the years, and presently there are twelve sites in the Saint John region, with monitors operated by NBDELG, industry, and Environment Canada. The latter agency's instruments form part of the Federal Government's National Air Pollution Surveillance (NAPS) network. The NBDELG has published ambient air quality reports for the Province of New Brunswick since 1997 (the first publication included both 1996 and 1997 results). In the Saint John area, there were (and continue to be) several sites which monitor SO_2, NO_2, PM, PM_{10}, $PM_{2.5}$. The latter two size ranges of airborne particulate matter are now considered to be of greater significance than PM, with respect to effects on air quality and health.

As was pointed out in the right hand column of Table 7.3 above, the permissible air quality levels for most contaminants in the Saint John region are the same as in the rest of New Brunswick, being derived from the National Ambient Air Quality Objectives' Acceptable (NAAQO) levels. However, in 1995, based on a recommendation from a Saint John stakeholder group, the Air Resource Management Area (ARMA) committee, the Provincial Minister for the Environment set the limit for sulfur dioxide in the Saint John region at half of the Federal Acceptable level. This makes it equivalent to the NAAQO Desirable level. On this basis, the existing ambient air quality in Saint John can be examined, and, the NAPS data is depicted in summary form in Table 7.5 for the years 1995-2000. A comparison of the data presented in the NAPS and Provincial (NBDELG) reports is shown in Table 7.6.

The 'background' concentrations of the air contaminants of primary interest are made up of three main components, these being: i) background emissions from natural sources; ii) emissions from nearby sources other than the one currently being assessed; and iii) the long range transport of pollutants which are emitted by distant sources and carried into the region of concern. The background, or baseline values are of importance since the determination can then be made as to the risk of the source causing adverse effects both of its own accord, as well as when considered in combination with the existing background levels.

The ambient annual means indicated in Table 7.6 are used in the modelling analysis to indicate whether or not the cumulative concentration (*i.e.,* background and CCGS) will be in exceedance of Provincial air quality standards.

This approach is conservative in nature, since the existing CCGS impact is not subtracted from the background prior to adding the modelled impacts from the refurbished generating station. Nonetheless, as will be shown, the effects on ground level air quality in Saint John for both cases is found to be small.

TABLE 7.5 Ambient Air Quality Monitoring Data 1995-2000 - National Air Pollution Surveillance (NAPS) Network Environmental Protection Service, Environment Canada

<table>
<tr><th></th><th colspan="4">1995</th><th colspan="4">1996</th><th colspan="4">1997</th><th colspan="4">1998</th><th colspan="4">1999</th><th colspan="4">2000</th></tr>
<tr><td>SO₂ (μg/m³)</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td></tr>
<tr><td>1-hour*</td><td colspan="2">94</td><td colspan="2">47</td><td colspan="2">94</td><td colspan="2">50</td><td colspan="2">113</td><td colspan="2">50</td><td colspan="2">123</td><td colspan="2">58</td><td colspan="2">144</td><td colspan="2">37</td><td colspan="2">110</td><td colspan="2">34</td></tr>
<tr><td>24-hour*</td><td colspan="2">66</td><td colspan="2">37</td><td colspan="2">66</td><td colspan="2">37</td><td colspan="2">84</td><td colspan="2">37</td><td colspan="2">87</td><td colspan="2">42</td><td colspan="2">110</td><td colspan="2">29</td><td colspan="2">79</td><td colspan="2">29</td></tr>
<tr><td>Annual Mean</td><td colspan="2">18</td><td colspan="2">13</td><td colspan="2">18</td><td colspan="2">13</td><td colspan="2">21</td><td colspan="2">13</td><td colspan="2">24</td><td colspan="2">16</td><td colspan="2">31</td><td colspan="2">13</td><td colspan="2">26</td><td colspan="2">11</td></tr>
<tr><td>NO₂ (μg/m³)</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td><td colspan="2">Site A</td><td colspan="2">Site B</td></tr>
<tr><td>1-hour*</td><td colspan="2">34</td><td colspan="2">62</td><td colspan="2">32</td><td colspan="2">53</td><td colspan="2">34</td><td colspan="2">45</td><td colspan="2">34</td><td colspan="2">40</td><td colspan="2">23</td><td colspan="2">51</td><td colspan="2">26</td><td colspan="2">53</td></tr>
<tr><td>24-hour*</td><td colspan="2">25</td><td colspan="2">47</td><td colspan="2">25</td><td colspan="2">43</td><td colspan="2">25</td><td colspan="2">36</td><td colspan="2">26</td><td colspan="2">32</td><td colspan="2">17</td><td colspan="2">40</td><td colspan="2">21</td><td colspan="2">43</td></tr>
<tr><td>Annual Mean</td><td colspan="2">11</td><td colspan="2">28□</td><td colspan="2">11</td><td colspan="2">23</td><td colspan="2">11</td><td colspan="2">19</td><td colspan="2">9</td><td colspan="2">17</td><td colspan="2">7□</td><td colspan="2">21</td><td colspan="2">6□</td><td colspan="2">12</td></tr>
<tr><td></td><td colspan="4">□9 of 12 monthly means</td><td colspan="4"></td><td colspan="4"></td><td colspan="4"></td><td colspan="4">□8 of 12 monthly means</td><td colspan="4">□7 of 12 monthly means</td></tr>
<tr><td>PM/TSP (μg/m³)</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td></tr>
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<tr><td>Annual Mean</td><td colspan="2">16</td><td colspan="2">28</td><td colspan="2">18</td><td colspan="2">25</td><td colspan="2">23</td><td colspan="2">32</td><td colspan="2">24□</td><td colspan="2">26</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td></tr>
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<tr><td>PM-10 (μg/m³)</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td><td colspan="2">Site A</td><td colspan="2">Site C</td></tr>
<tr><td></td><td>M1</td><td>M2</td><td>M3</td><td>M2</td><td>M1</td><td>M2</td><td>M3</td><td>M2</td><td>M1</td><td>M2</td><td>M3</td><td>M2</td><td>M1</td><td>M2</td><td>M3</td><td>M2</td><td>M1</td><td>M2</td><td>M3</td><td>M2</td><td>M1</td><td>M2</td><td>M3</td><td>M2</td></tr>
<tr><td>1-hour**</td><td>-</td><td>-</td><td>-</td><td>-</td><td>18</td><td></td><td></td><td></td><td>29</td><td></td><td></td><td></td><td>34</td><td></td><td></td><td></td><td>33</td><td></td><td></td><td></td><td>35</td><td></td><td></td><td></td></tr>
<tr><td>24-hour**</td><td>-</td><td>18</td><td>23</td><td>26</td><td>17</td><td>18</td><td>20</td><td>35</td><td>25</td><td>27</td><td>20</td><td>40</td><td>28</td><td>26</td><td>30</td><td>41</td><td>28</td><td>39</td><td>26</td><td>51</td><td>28</td><td>15</td><td>-</td><td>20</td></tr>
<tr><td>Annual Mean</td><td>-</td><td>10</td><td>13</td><td>17</td><td>11~</td><td>12</td><td>11</td><td>20</td><td>15</td><td>16</td><td>12□</td><td>22☆</td><td>17□</td><td>16</td><td>15✲</td><td>24</td><td>16</td><td>18✱</td><td>14✶</td><td>26☆</td><td>16</td><td>11•</td><td>-</td><td>20</td></tr>
<tr><td></td><td colspan="4"></td><td colspan="4">~1 of 12 monthly means</td><td colspan="4">☆10 of 12 monthly means
□8 of 12 monthly means</td><td colspan="4">□8 of 12 monthly means
✲2 of 12 monthly means</td><td colspan="4">✱7 of 12 monthly means
☆10 of 12 monthly means
✶3 of 12 monthly means</td><td colspan="4">•5 of 12 monthly means</td></tr>
<tr><td>PM 2.5 (μg/m³)</td><td colspan="2">Site A</td><td colspan="2">Site A</td><td colspan="2">Site A</td><td colspan="2">Site A</td><td colspan="2"></td><td colspan="2">Site A</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
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<tr><td>1-hour</td><td colspan="2">-</td><td colspan="2"></td><td colspan="2">13</td><td colspan="2"></td><td colspan="2">18</td><td colspan="2"></td><td colspan="2">19</td><td colspan="2"></td><td colspan="2">15</td><td colspan="2"></td><td colspan="2">7</td><td colspan="2"></td></tr>
<tr><td>24-hour</td><td colspan="2">-</td><td colspan="2"></td><td colspan="2">12</td><td colspan="2"></td><td colspan="2">15</td><td colspan="2"></td><td colspan="2">16</td><td colspan="2"></td><td colspan="2">13</td><td colspan="2"></td><td colspan="2">14</td><td colspan="2"></td></tr>
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<tr><td></td><td colspan="4"></td><td colspan="4">▼1 of 12 monthly means</td><td colspan="4"></td><td colspan="4">▼7 of 12 monthly means</td><td colspan="4">▼7 of 12 monthly means</td><td colspan="4"></td></tr>
</table>

Site A - Forest Hills	M1 – TEOM - Tapered Element Oscillating Microbalance
Site B - 189 Prince William	M2 – SSI - Site Selective Inlet Sampler
Site C - 110 Charlotte Street	M3 – Dichotomous Sampler

* 95th percentile ** 90th percentile

TABLE 7.6 Ambient Air Quality Monitoring Data – Annual Means
NBDELG (1995-1999) and NAPS (1995-2000)

Air Contaminant	NBDELG	NAPS	Mean
sulphur dioxide (μg/m^3)	17.5	18.1	17.8
nitrogen dioxide (μg/m^3)	15.7	14.6	15.2
particulate matter (μg/m^3)	22.4	24.0	23.2

SO_2

Based on the monitored results during the period in question, the Saint John 1-hour and 24-hour SO_2 standards were never exceeded at five of the seven stations, and compliance at the other two stations in 1999 ranged from 99.71 to 99.95%. Only two exceedances of the annual standard of 30 μg/m^3 (11ppb) over the six year period occurred, at the Forest Hills Station in 1999 (11.5ppb) and at the Forest Products Station in 1997 (14ppb).

Annual mean trends of SO_2 in Saint John have decreased significantly in the past 20 years; with changes in local power generation and various industrial facilities being stated as reasons for the improvement. However, during 1995-2000, there was a leveling off of the trend, with differences between individual stations. The Forest Hills monitor annual mean increased from 18-26 μg/m^3 from 1995 to 2000, while the Post Office/Customs Building Station annual mean decreased from 13-11 μg/m^3 over the same period. Nonetheless, the long-term trend has been that of significantly decreasing ground level concentrations.

NO_2

In terms of the provincial standards (identical to the acceptable NAAQO's) for NO_2, no exceedances have been recorded in Saint John during the period from 1995-2000. Annual mean values measured at the downtown location (Post Office/Customs Building) tended to be somewhat higher than at the Forest Hills location, and may reflect the influence of heavier vehicle traffic near the downtown monitoring station.

The measured annual means for Forest Hills ranged from 6-11 μg/m^3 over the period, while the means for the downtown location ranged from 12-28 μg/m^3, well below the annual standard of 100 μg/m^3. The long-term trends for NO_2 appear to be slightly decreasing at Forest Hills, and slightly increasing at the Customs Building downtown. Overall, the average concentrations are fairly flat, and this may reflect the offsetting issues of better emissions controls versus increased traffic density. While the ambient levels of nitrogen dioxide are well below regulatory requirements, this pollutant is of particular importance as a precursor to O_3 formation.

PM

Particulate matter (also known as total suspended particulate matter – TSP) was measured at both Forest Hills and the downtown location until 1999, when monitoring of this parameter was discontinued. PM has fallen out of favour as the best indicator, since it was determined that it was mainly fine particulates which were implicated as health factors. Monitoring efforts have been redirected to the particulate fractions known as PM_{10} and $PM_{2.5}$, which are discussed below. In the years 1996 through 1998, the 24-hour measured values of TSP (one sample taken every six days) were below the Provincial standard for all but two occurrences at Forest Hills, both of which occurred in 1996. Annual means for PM were well below the standard at all monitoring locations for all years, with values ranging from 16-22 $\mu g/m^3$ at Forest Hills and 100 Charlotte Street, and from 22-31 $\mu g/m^3$ at the Provincial Building.

The NBDELG Air Quality Report for 1999 indicates that PM values have decreased to less than half of what they were during the 1980's. These improvements are generally attributed to better emission control on both stationary and mobile sources, as well as to a reduction in open burning activities. Values have been found to increase during periods of high construction activity.

PM_{10}

The inhalable particulate matter (particles having an equivalent diameter of 10 microns or less) is monitored at four sites in Saint John using high volume sampler technology (one 24-hour sample every six days). Although there is no established regulatory limit for PM_{10} in New Brunswick, the 50 $\mu g/m^3$ (24-hour) objective set by the state of California and the GRVD was exceeded six times at the Hillcrest site, eight times at the Provincial Building, twice at Forest Hills and four times at the Western District Station during 1999. This number of exceedances was higher than in previous years, and is potentially attributed to increased construction activity in Saint John.

The annual mean concentrations of PM_{10} monitored by NBDELG during the period 1995-1999 ranged from 9-19 $\mu g/m^3$ at Forest Hills, and from 17-29 $\mu g/m^3$ at the Provincial Building. The NAPS data for the 1995-2000 period ranged from 10-26 $\mu g/m^3$, showing good agreement between the two reports. The trend in annual means for PM_{10} since 1984 has shown a slight decrease over time; however, there was a notable increase in the annual average at Forest Hills in 1999. The average, nevertheless, was less than 20 $\mu g/m^3$ as measured by three different technologies (Table 7.5).

$PM_{2.5}$

Respirable particulate matter (particles having an equivalent diameter of 2.5 microns or less) was monitored by NBDELG at one site (Forest Hills) during 1999 using TEOM technology, which gives continuous hourly readings. Although sufficient data was not collected to compare with the Canada Wide Standard of 30 $\mu g/m^3$ as a 24 hour average over three years (based on the 98th percentile), the measured 24-hour values did not exceed this value during the year. The 98th percentile was 18.4 $\mu g/m^3$.

The NAPS data, which covers the period from 1996-2000, albeit with incomplete data sets for three of those years, shows 24-hour means of 12-16 $\mu g/m^3$ at the Forest Hills Station, indicating reasonable agreement with the Provincial data range for 1999.

7.2.1.3 Likely Future Conditions

In relation to the baseline scenario, future spatial and meteorological conditions would not be expected to change significantly over the projected 25-year lifetime of the refurbished CCGS. However, the current high-profile issue of climate change makes it difficult to assess the likelihood of normal climatological parameters over the coming decades. Predicted changes in global temperature might be expected to lead to increased winds, and atmospheric instability; however, predictions for temperature fluctuations in the Atlantic coastal region are for moderate changes. There is general scientific agreement that climate variability has increased, and that more extreme weather events can be anticipated. Storm severity may increase, precipitation extremes may occur, and the hydrological balance may be affected.

The issue of climate change and the role of CO_2 as a greenhouse gas has implications for all combustion processes in terms of the effect on climate, as well as the Provincial/National/International agreements and regulations which exist or may be brought to fruition in years to come. The Kyoto Protocol, although not as yet ratified by Canada, would call for this country to reduce its GHG emissions by 6% below 1990 levels between 2008 and 2012. In August, 2001, The Conference of NEG/ECP developed an Action Plan whose key goal was to stabilize emissions at 1990 levels by 2010, and to target reductions of 10% by 2020. These targets are for the region as a whole, and the Plan envisions the creation of a regional registry and the exploration of a trading mechanism.

For NB Power, this is a corporate issue which needs to be addressed on a system-wide basis, as was done to meet the SO_2 caps established to deal with acid rain Coleson Cove's specific role in these options would depend on economic factors at the time targets were implemented. A number of options have been identified that would allow NB Power to manage GHG emissions. Many of these are discussed in detail in NB Power's submissions to the PUB as part of the Coleson Cove and Point Lepreau hearings (see Appendix E attached). Additional potential reductions through sponsorship of offset projects have been identified since those submissions. A summary of the potential reductions available from the different options is provided in the Table titled "CO_2 Reduction Potential Options" in Appendix E.

As noted, ambient levels for both SO_2 and PM have fallen substantially in Saint John over the past 20 years, with some leveling off of this trend more recently. Further gains in air quality become more difficult to achieve as one approaches the 'background' levels.

7.2.2 Effects Assessment

7.2.2.1 Methods

The methodology for the air quality modelling analysis involved four components, these being; i) source analysis; ii) meteorological data preparation; iii) dispersion modelling; and iv) comparison of results with regulatory standards.

Source Analysis

The source data required to run the dispersion model includes the following parameters: the physical location of the stack, the emission rate, the release height above grade, the exhaust gas exit velocity, the inside diameter of the stack, and the exhaust gas temperature at the stack exit. Additional inputs are optional, including source elevation, building dimensions, particle size distributions and related settling data, and surface reflection coefficients.

The site plan for the CCGS is shown in Figure 7.2, and indicates the existing 183 m high stack containing three flues, one for each of the 350 MW boiler/turbine units. A new stack is proposed which will take the exhaust gases from the FGD unit. This stack will also be 183 m high, with two flues, each to handle exhaust gas flows associated with 525 MW of generation.

The modelling analysis was carried out for both cases using three generating load scenarios, low (80 MW), medium (525 MW), and high (1050 MW). It should be noted that when predicting annual effects on air quality, the high load scenario is a conservative approach, since a generating station would not, in reality, operate at full load for a year. The stack parameters and emission rates for Fuel Oil #6 and for Orimulsion® are provided in Tables 7.7 and 7.8. In addition, Table 7.9 provides a comparison of the Canadian New Source Performance Standards for new generating facilities, as well as the design target for the refurbished CCGS.

As indicated in Figure 7.2 the terrain surrounding the CCGS is relatively flat and predominantly rural, with a few zones of high relief within 30 km. These areas include Crane Mountain, Nowland Hill and Charlotte Bluff, all located approximately 11 km north. The highest terrain on the grid is approximately 190 m above mean sea level (msl), and is located at the northwest corner of the grid.

TABLE 7.7 Stack Parameters for Existing Operation – Fuel Oil #6 - Data Source: JWEL (2002)

Parameter	Existing Stack		
Operating Load	Low	Medium	Full or High
Stack Height (m)	182.9	182.9	182.9
Number of flues	1	2	3
Equivalent Stack Diameter (m)	4.9	6.93	8.487
Flowrate (m^3/s)	129.3	848.6	1697
Exit Velocity (m/s)	6.86	22.5	30
Exit Temperature C	121	150	170
Total Emissions			
Sulphur dioxide (g/s)	245	1,606	3,212
Nitrogen oxides (g/s)	65	427	854
Total Particulate Matter (g/s)	4.2	27.5	55
PM_{10} (g/s)	3.4	22.5	45
$PM_{2.5}$ (g/s)	2.2	14.5	29

TABLE 7.8 Stack Parameters for Post-Refurbishment Operations - Orimulsion®
Data Source: JWEL (2002)

Parameter	New Stack – Brick Liner		
Operating Load	Low	Medium	Full or High
Stack Height (m)	182.9	182.9	182.9
Number of flues	1	1	2
Equivalent Stack Diameter (m)	7.77	7.77	10.99
Flowrate (m^3/s)	124.2	714	1,428
Exit Velocity (m/s)	2.62	15.06	15.06
Exit Temperature (C)	57	61	61
Total Emissions			
Sulphur dioxide (g/s)	59	388	777
Nitrogen oxides (g/s)	21	136	272
Total Particulate Matter (g/s)	1.0	6.5	13.0
PM_{10} (g/s)	0.8	5.5	11.0
$PM_{2.5}$ (g/s)	0.5	3.5	7.0

TABLE 7.9 Guidelines and Design Emission Rates

Contaminant	Canadian Limit/Guideline (new source)	CCGS Design Target
SO_2	0.60 lbs/MMBTU	0.60 lbs/MMBTU
NOx	0.26 lbs/MMBTU	0.21 lbs/MMBTU
PM	0.10 lbs/MMBTU	0.01 lbs/MMBTU

Facility Emissions

The existing CCGS is operated using Fuel Oil #6, running three generating units of up to 350 MW each. The exhaust gases are directed from the boilers through a dry ESP, and then to three individual flues within the one stack.

The proposed refurbished CCGS will burn Orimulsion®, in a similar fashion; however, the boiler gases will be directed through a dry ESP, then through one of two proposed FGD systems, each capable of handling exhaust gases from 80 MW to 525 MW of power generation, and from there to the two WESP (Figure 4.2). The gases then are exhausted through two separate flues within the one new stack. The emissions and other stack parameters from the existing CCGS and the proposed refurbished CCGS are shown under three different generating load scenarios in Tables 7.7 and 7.8. As indicated, the refurbished generating station will reduce emission rates by approximately 77% for SO_2, 70% for NOx, and 75% for PM. Table 7.10 summarizes the total emissions associated with the Project.

TABLE 7.10 Total Emissions Associate with the Project

Pollutant	Emission Source	Existing Fuel Oil No.6 (at 65% CF)	Future Orimulsion® (at 65% CF)	Future Orimulsion® (at 85% CF)
SO_2 (kt/year)	CCGS Operation	65.8	15.9	20.8
	Vehicle Traffic	0.11	0.11	0.11
	Marine Vessels	0.11	0.10	0.10
	Total	**66.1**	**16.1**	**21.0**
CO_2 (Mte/year)	CCGS Operation	4.384	4.329	5.661
	Vehicle Traffic	0.040	0.041	0.041
	Marine Vessels	0.007	0.006	0.006
	Total	**4.431**	**4.376**	**5.708**
NOx (kt/year)	CCGS Operation	17.5	5.6	7.3
	Vehicle Traffic	0.26	0.28	0.28
	Marine Vessels	0.11	0.10	0.10
	Total	**17.88**	**5.96**	**7.67**
Particulate (kt/year)	CCGS Operation	1.13	0.27	0.35
	Vehicle Traffic	0.034	0.035	0.035
	Marine Vessels	0.003	0.003	0.003
	Total	**1.16**	**0.30**	**0.39**

Legend: CF – Capacity Factor

Special operating conditions which have the potential to affect emissions include startup, shutdown, and upset operating conditions. For the refurbished station, during a cold startup, with the boiler house at or near room temperature, the ignitors would be fuelled with light oil for up to six hours. When operating temperature is reached, the wet and dry precipitators and the FGD unit are brought on-line, and then fuel is switched to Orimulsion®. Thus, emissions for the start-up period would be similar to plants burning light fuel oil. A hot startup of the plant occurs when, for any of a variety of reasons, a boiler, generator or turbine trip has occurred. The startup procedure normally takes 1.5-2 hours, and operation is switched to light fuel oil.

The switch back to Orimulsion® coincides within a few minutes of the startup of the emissions control equipment. Recent experience with the CCGS indicates that cold and hot startups per unit are encountered an average of five and 14 times per year respectively.

Upset conditions are those wherein a trip of a unit occurs while power is being generated. In these cases, the exhaust gases are bypassed to the existing stack, and load is immediately decreased. The bypass would be expected to occur for a maximum of 10-20 minutes. NB Power's Dalhousie plant has been operating on Orimulsion® since 1994, and has never experienced this type of upset condition. Given the short-term nature, and relative infrequency of these events, the consequences for air quality effects are negligible and are not considered further. However, the dispersion for low load conditions would be reasonably representative of the outcome for cold and hot startups, and is assessed on that basis.

Plume Dispersion

The calculation of the effects of emissions on ground level air quality for both cases was carried out using the most recent edition of the Industrial Source Complex (ISC) dispersion model as developed by the US EPA. Termed ISC-PRIME, this model also accounts for the effects of the CCGS buildings on plume characteristics, although in this case, the height of the stack minimizes such effects. The model uses the weather data noted above in Section 7.2.1.2, and also incorporates computations of the atmospheric stability, as well as the terrain elevation at each point on the modelled grid. Ground level concentrations were computed for approximately 6,480 grid points (receptors) for all cases, with the grid nodes spaced 100 m apart extending from the source out to 3 km, 500 m apart for distances from 3 to 10 km, and 1000 m apart for the remainder of the grid. The receptor grid is depicted in Figure 7.1.

The results of the dispersion modelling were focused on, for each of the two scenarios, and for the three load conditions, the maximum ground level concentration, and second highest ground level concentration found at any receptor using the six years of meteorological data. These results are shown in Tables 7.11 through 7.16 for SO_2, PM, PM_{10}, $PM_{2.5}$, and NOx, along with their respective regulatory limits. It should be noted that for the existing case (Fuel Oil #6), the model indicates that, under full load, the calculated maximum ground level concentration for SO_2 would exceed regulatory limits. However, the operating practice for the CCGS is that a SCS is run on a daily basis. A dispersion model is run using actual meteorological conditions, and predicted ground level concentrations are compared to the objectives. Should the calculated concentration be too high, then action is taken to limit the generation so as to reduce emissions, and thus keep ground level concentrations below regulatory standards.

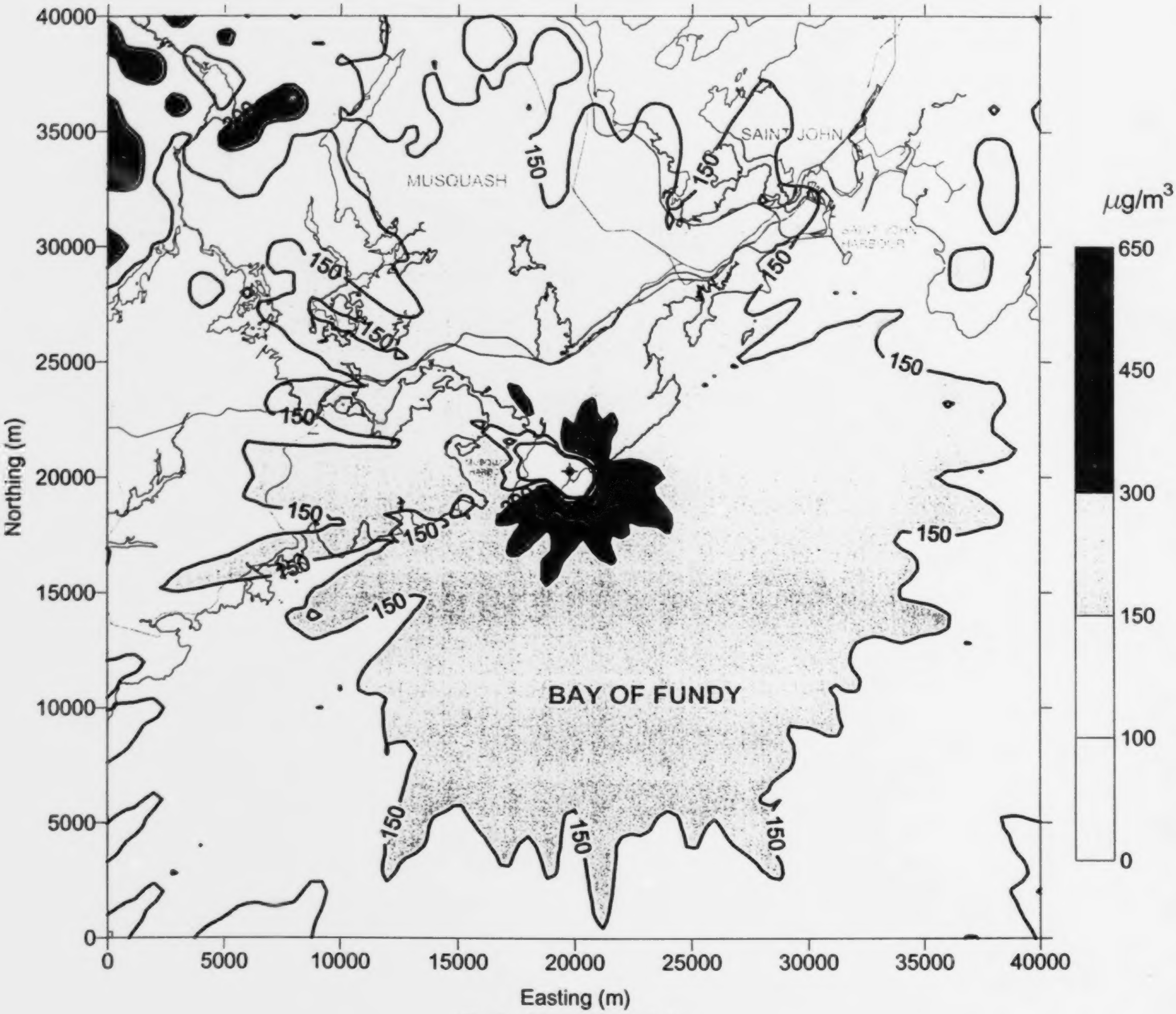
The predicted peak SO_2 concentrations when fueled with #6 fuel were found to occur quite close to the generating station, about 1.6 km to the Southeast (over the Bay of Fundy). Since the model indicated a potential for SO_2 ground level concentrations to exceed the one-hour standard, an estimate of the frequency of exceedances was conducted using two thresholds, one being the regulated standard (450 $\mu g/m^3$), the other being half that level (225 $\mu g/m^3$). The frequencies of these occurrences at any one receptor over the full six year period are less than 0.05% and less than 0.1% respectively. By way of illustration, Figures 7.4 and 7.5 indicate the contours of equal concentration for maximum 1-hour SO_2 levels for the medium load cases for the existing (Fuel Oil #6) and for Orimulsion® respectively. These contour plots are computed for all averaging times, the three load scenarios, for each pollutant, and may be found in the JWEL Technical Report "CCGS Refurbishment Project, Environmental Impact Assessment Report: Air Quality Study – Dispersion Modelling Assessment, March 8, 2002".

The predicted 24-hour maximums and annual averages at all three loads for both cases are below the regulatory standards. Combining the measured mean annual background values of approximately 18 $\mu g/m^3$ in Saint John, with the predicted mean annual levels of 1.6-2.8 $\mu g/m^3$ results in a total of 19-21 $\mu g/m^3$. This is well below the annual regulatory limit of 30 $\mu g/m^3$, and indicates that the contribution of CCGS emissions to SO_2 in Saint John is relatively small.

Figure 7.4 - Modelling of Generating Station Emissions

Existing Stack - Fuel Oil #6
Medium Load

NB Power
Coleson Cove Generating Station
Lorneville, New Brunswick


40000
35000
30000
25000
20000
15000
10000
5000
0
Northing (m)
0
5000
10000
15000
20000
25000
30000
35000
40000
Easting (m)
MUSQUASH
SAINT JOHN
SAINT JOHN HARBOUR
BAY OF FUNDY
150
300
μg/m³
650
450
300
150
100
0

Sulphur Dioxide
Predicted 1 Hour Maximum, μg/m3

LEGEND

✦ Coleson Cove Generating Station

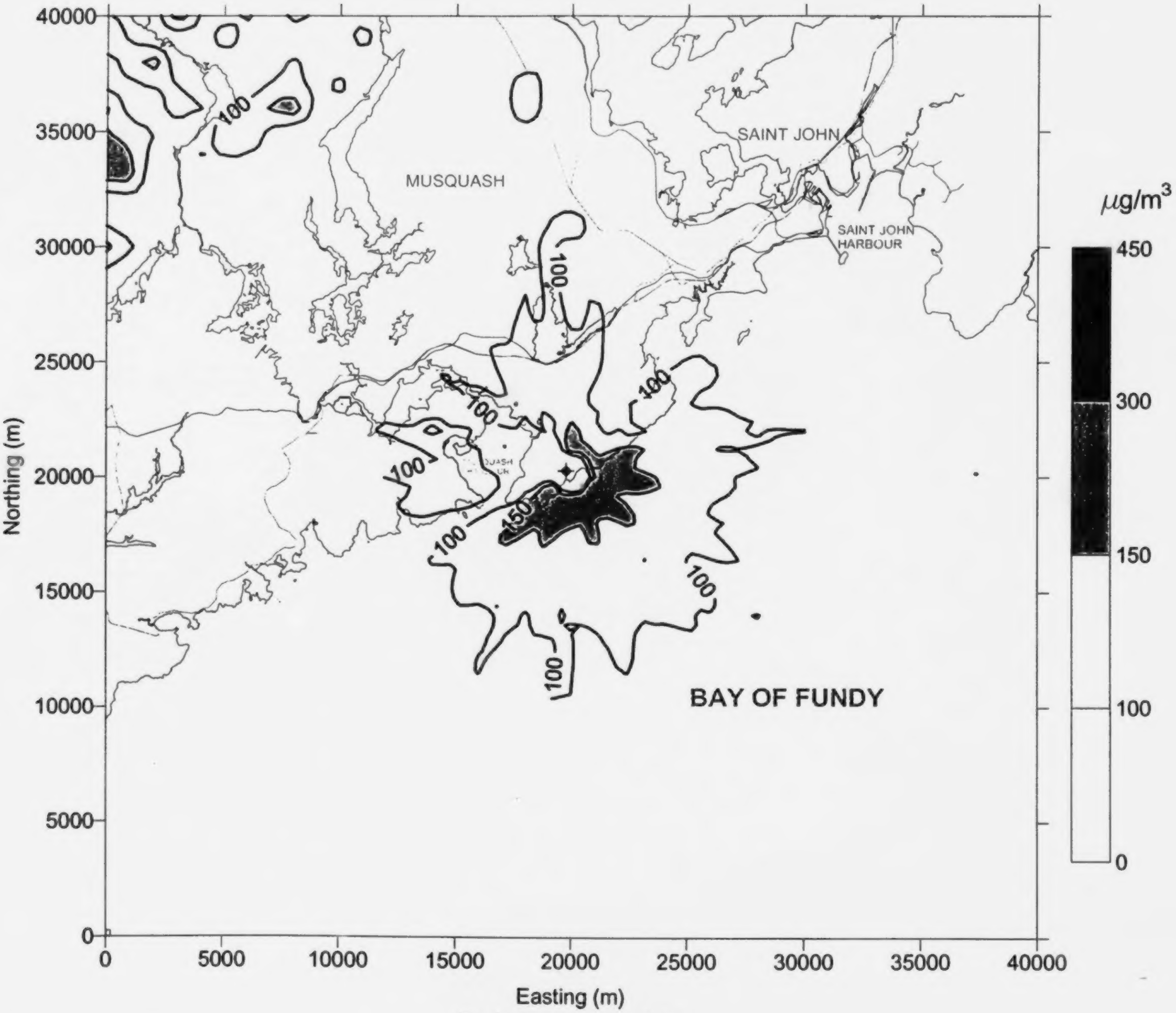
450 Regulatory Limit, μg/m3

Jacques Whitford Environment Limited

Figure 7.5 - Modelling of Generating Station Emissions

FGD Stack - ORIMULSION®
Medium Load

NB Power
Coleson Cove Generating Station
Lorneville, New Brunswick



SAINT JOHN
MUSQUASH
SAINT JOHN HARBOUR
BAY OF FUNDY
100
150
Northing (m)
Easting (m)
0
5000
10000
15000
20000
25000
30000
35000
40000
µg/m3
450
300
150
100
0

Sulphur Dioxide
Predicted 1 Hour Maximum, µg/m3

LEGEND

✦ Coleson Cove Generating Station

450 Regulatory Limit, µg/m3

Jacques Whitford Environment Limited

TABLE 7.11 Summary of Short-Term Dispersion Modelling Results Existing Operation – Fuel Oil #6 – Low Load

Pollutant	Averaging Period	Maximum Receptor Value ($\mu g/m^3$)		X-Coord (m)	Y-Coord (m)	National and New Brunswick Ambient Air Quality Objectives ($\mu g/m^3$)
PM	24 Hr	1st Highest	0.737	20300	22200	120
		2nd Highest	0.728	20400	22300	
PM	Annual	1st Highest	0.028	25500	29000	70
		2nd Highest	0.025	26500	30000	
PM<10	24 Hr	1st Highest	0.596	20300	22200	501
		2nd Highest	0.590	20400	22300	
PM <2.5	24 Hr	1st Highest	0.386	20300	22200	302
		2nd Highest	0.382	20400	22300	
SO_2	1 Hr	1st Highest	305	19000	19300	450
		2nd Highest	298	19000	19200	
SO_2	24 Hr	1st Highest	43.0	20300	22200	150
		2nd Highest	42.5	20400	22300	
SO_2	Annual	1st Highest	1.61	25500	29000	30
		2nd Highest	1.47	26500	30000	
NOx	1 Hr	1st Highest	81.0	19000	19300	400
		2nd Highest	78.9	19000	19200	
NOx	24 Hr	1st Highest	11.4	20300	22200	200
		2nd Highest	11.3	20400	22300	
NOx	Annual	1st Highest	0.426	25500	29000	100
		2nd Highest	0.390	26500	30000	

Notes:
1. The CCGS stack is located at x=20,000, and y=20,000.
2. Originally proposed Canada Wide Standard, 1998, GVRD Standard, 2001.
3. Canada Wide Standard, 2000.

TABLE 7.12 Summary of Short-Term Dispersion Modelling Results Existing Operation – Fuel Oil #6 – Medium Load

Pollutant	Averaging Period	Maximum Receptor Value (µg/m³)		X-Coord (m)	Y-Coord (m)	National and New Brunswick Ambient Air Quality Objectives (µg/m³)
PM	24 Hr	1st Highest	1.19	21000	25500	120
		2nd Highest	1.18	21000	26000	
PM	Annual	1st Highest	0.047	30000	38000	70
		2nd Highest	0.045	29000	37000	
PM<10	24 Hr	1st Highest	0.970	21000	25500	501
		2nd Highest	0.968	21000	26000	
PM <2.5	24 Hr	1st Highest	0.625	21000	25500	302
		2nd Highest	0.624	21000	26000	
SO_2	1 Hr	1st Highest	651	21300	20000	450
		2nd Highest	648	21300	19900	
SO_2	24 Hr	1st Highest	69.2	21000	25500	150
		2nd Highest	69.1	21000	26000	
SO_2	Annual	1st Highest	2.77	30000	38000	30
		2nd Highest	2.60	29000	37000	
Nox	1 Hr	1st Highest	173	21300	20000	400
		2nd Highest	172	21300	19900	
Nox	24 Hr	1st Highest	18.4	21000	25500	200
		2nd Highest	18.4	21000	26000	
Nox	Annual	1st Highest	0.737	30000	38000	100
		2nd Highest	0.692	29000	37000	

Notes: 1. Originally proposed Canada Wide Standard, 1998, GVRD Standard, 2001.
2. Canada Wide Standard, 2000.

TABLE 7.13 Summary of Short-Term Dispersion Modelling Results Existing Operation – Fuel Oil #6 – Full Load

Pollutant	Averaging Period	Maximum Receptor Value (µg/m³)		X-Coord (m)	Y-Coord (m)	National and New Brunswick Ambient Air Quality Objectives (µg/m³)
PM	24 Hr	1st Highest	1.16	19600	18400	120
		2nd Highest	1.15	19700	18400	
PM	Annual	1st Highest	0.041	30000	38000	70
		2nd Highest	0.038	31000	38000	
PM<10	24 Hr	1st Highest	0.951	19600	18400	501
		2nd Highest	0.940	19700	18400	
PM <2.5	24 Hr	1st Highest	0.613	19600	18400	302
		2nd Highest	0.606	19700	18400	
SO_2	1 Hr	1st Highest	755	21400	19300	450
		2nd Highest	755	21400	19400	
SO_2	24 Hr	1st Highest	67.8	19600	18400	150
		2nd Highest	67.1	19700	18400	
SO_2	Annual	1st Highest	2.38	30000	38000	30
		2nd Highest	2.23	31000	38000	
NOx	1 Hr	1st Highest	201	21400	19300	400
		2nd Highest	201	21400	19400	
NOx	24 Hr	1st Highest	18.0	19600	18400	200
		2nd Highest	17.8	19700	18400	
NOx	Annual	1st Highest	0.633	30000	38000	100
		2nd Highest	0.594	31000	38000	

Notes: 1. Originally proposed Canada Wide Standard, 1998, GVRD Standard, 2001.
2. Canada Wide Standard, 2000.

TABLE 7.14 Summary of Short-Term Dispersion Modelling Results Post-Refurbishment - Orimulsion® - Low Load

Pollutant	Averaging Period	Maximum Receptor Value (μg/m^3)		X-Coord (m)	Y-Coord (m)	National and New Brunswick Ambient Air quality Objectives (μg/m^3)
PM	24 Hr	1st Highest 2nd Highest	0.301 0.300	20400 20400	22200 22100	120
PM	Annual	1st Highest 2nd Highest	0.010 0.0099	25500 22500	29000 23500	70
PM<10	24 Hr	1st Highest 2nd Highest	0.241 0.240	20400 20400	22200 22100	501
PM <2.5	24 Hr	1st Highest 2nd Highest	0.150 0.150	20400 20400	22200 22100	302
SO_2	1 Hr	1st Highest 2nd Highest	101 97.7	19400 19300	19500 19600	450
SO_2	24 Hr	1st Highest 2nd Highest	17.8 17.8	20400 20400	22200 22100	150
SO_2	Annual	1st Highest 2nd Highest	0.594 0.585	25500 22500	29000 23500	30
NOx	1 Hr	1st Highest 2nd Highest	35.3 34.2	19400 19300	19500 19600	400
NOx	24 Hr	1st Highest 2nd Highest	6.23 6.21	20400 20400	22200 22100	200
NOx	Annual	1st Highest 2nd Highest	0.208 0.205	25500 22500	29000 23500	100

Notes: 1. Originally proposed Canada Wide Standard, 1998, GVRD Standard, 2001.
2. Canada Wide Standard, 2000.

TABLE 7.15 Summary of Short-Term Dispersion Modelling Results Post-Refurbishment - Orimulsion®-Medium Load

Pollutant	Averaging Period	Maximum Receptor Value (μg/m^3)		X-Coord (m)	Y-Coord (m)	National and New Brunswick Ambient Air quality Objectives (μg/m^3)
PM	24 Hr	1st Highest 2nd Highest	0.479 0.470	20600 20700	22800 22800	120
PM	Annual	1st Highest 2nd Highest	0.021 0.020	25500 30000	29000 38000	70
PM<10	24 Hr	1st Highest 2nd Highest	0.405 0.398	20600 20700	22800 22800	501
PM <2.5	24 Hr	1st Highest 2nd Highest	0.258 0.253	20600 20700	22800 22800	302
SO_2	1 Hr	1st Highest 2nd Highest	330 325	21000 20900	19500 19500	450
SO_2	24 Hr	1st Highest 2nd Highest	28.6 28.1	20600 20700	22800 22800	150
SO_2	Annual	1st Highest 2nd Highest	1.27 1.22	25500 30000	29000 38000	30
NOx	1 Hr	1st Highest 2nd Highest	116 114	21000 20900	19500 19500	400
NOx	24 Hr	1st Highest 2nd Highest	10.0 9.84	20600 20700	22800 22800	200
NOx	Annual	1st Highest 2nd Highest	0.445 0.426	25500 30000	29000 38000	100

Notes: 1. Originally proposed Canada Wide Standard, 1998, GVRD Standard, 2001.
2. Canada Wide Standard, 2000.

TABLE 7.16 Summary of Short-Term Dispersion Modelling Results Post-Refurbishment - Orimulsion® - Full Load

Pollutant	Averaging Period	Maximum Receptor Value ($\mu g/m^3$)		X-Coord (m)	Y-Coord (m)	National and New Brunswick Ambient Air quality Objectives ($\mu g/m^3$)
PM	24 Hr	1st Highest	0.651	21000	25500	120
		2nd Highest	0.630	21000	26000	
PM	Annual	1st Highest	0.026	30000	38000	70
		2nd Highest	0.024	29000	37000	
PM<10	24 Hr	1st Highest	0.551	21000	25500	50[1]
		2nd Highest	0.533	21000	26000	
PM <2.5	24 Hr	1st Highest	0.350	21000	25500	30[2]
		2nd Highest	0.339	21000	26000	
SO_2	1 Hr	1st Highest	424	20000	18900	450
		2nd Highest	419	20000	18800	
SO_2	24 Hr	1st Highest	38.9	21000	25500	150
		2nd Highest	37.7	21000	26000	
SO_2	Annual	1st Highest	1.55	30000	38000	30
		2nd Highest	1.46	29000	37000	
NOx	1 Hr	1st Highest	148	20000	18900	400
		2nd Highest	147	20000	18800	
NOx	24 Hr	1st Highest	13.6	21000	25500	200
		2nd Highest	13.2	21000	26000	
NOx	Annual	1st Highest	0.542	30000	38000	100
		2nd Highest	0.511	29000	37000	

Notes: 1. Originally proposed Canada Wide Standard, 1998, GVRD Standard, 2001.
2. Canada Wide Standard, 2000.

As can be seen in Tables 7.11 through 7.16, the predicted levels for NOx, PM, PM_{10} and $PM_{2.5}$ are all well below regulatory standards.

For NOx, the modelling analysis assumed that all NO in the exhaust was converted to NO_2, whereas in most combustion processes NO makes up about 90-95% of the NOx with the remainder being NO_2. Thus the NO_2 results would be high (conservative). Nonetheless, the predicted maximum values for one-hour, 24-hour and annual effects are well below the regulatory limits. The spatial distribution patterns are similar to SO_2, which is as expected since the model treats the gases in a like manner. When the annual range of maximum effect (0.4-0.8 $\mu g/m^3$) is combined with the mean annual background levels of 14.6-15.7 $\mu g/m^3$, the total (15-17 $\mu g/m^3$) is well below the standard of 100 $\mu g/m^3$.

The predicted levels for total suspended particulate (PM), PM_{10} and $PM_{2.5}$ are all well below regulatory standards. (There is no applicable regulatory standard for PM_{10}; however, the standard used by the GVRD has been used for comparison.) The maximum predicted annual PM is in the range of 0.0099-0.026 $\mu g/m^3$ depending on load as compared to annual background concentrations of 22.4-24.0 $\mu g/m^3$, and a standard of 70 $\mu g/m^3$. The 24-hour maximums for PM_{10} and $PM_{2.5}$ are 0.6 $\mu g/m^3$ and 0.4 $\mu g/m^3$ respectively, well below the respective standards of 50 $\mu g/m^3$ (GVRD) and 30 $\mu g/m^3$ (Canada Wide Standard).

Emissions Comparison

As has been noted previously, the emission rate for any given load and pollutant for the Project is substantially less than that for the existing plant. Table 7.17 depicts the rate for both operations at 1050 MW, running 65% (capacity factor) of the year. The annual emissions for SO_2, NOx, PM, PM_{10} and $PM_{2.5}$ can be seen to be much lower for the proposed operation when compared to the existing case.

TABLE 7.17 Comparison of Existing and Future Emissions at Coleson Cove 65% Capacity Factor

Pollutant	Existing Operation Fuel Oil #6		Post-Refurbishment Operation Orimulsion®	
	lb/MMBtu	Tonnes/year	lb/MMBtu	tonnes/year
SO_2	2.63	65,878	0.60	15,927
NOx	0.70	17,506	0.21	5,576
PM	0.045	1,127	0.010	267
PM_{10}	0.037	922	0.008	226
$PM_{2.5}$	0.023	595	0.005	144

Ground Level Effects

For the existing operation, the maximum ground level concentrations for all pollutants are slightly higher at high load than for medium or low load operations, particularly within about 5 km from the source. At about 10 km from the source, high and medium loads yield similar ground level concentrations. For longer term averages (24 hour and annual), the medium load scenario ground level concentrations are slightly higher than for the high load, due to lower gas exit velocity and temperature, and the subsequent reduction in plume rise.

The nature of flue gas desulphurization leads to a humid, cooler exhaust gas, which means that the exit velocity and initial plume rise from the stack are reduced. Thus the maximum ground level concentrations would be expected to occur closer to the facility, so that the dispersion patterns for the two cases are not identical. Nevertheless, the predicted ground level concentrations for the Project are generally lower than for the existing CCGS. The maximum levels are substantially below those associated with Fuel Oil #6, and all fall below regulatory limits.

7.2.3 Air Quality Monitoring

NB Power presently monitors the emissions of combustion gases and particulate matter from the CCGS. These emissions are monitored for plant and combustion control, and to comply with conditions specified in their COA to operate.

The emissions of NOx, CO and O_2 are monitored using a CEM system. In addition to these monitors, the emissions of sulphur dioxide are monitored by a SCEM program. The SCEM uses plant operational data, including fuel flow, fuel analysis, unit operating load, and O_2 content of the flue gas to calculate the emission rate of SO_2 to the atmosphere. NB Power also operates continuous opacity monitors downstream of the ESP (as stated in the COA).

The CEM program is supplemented by source emissions testing that is conducted in compliance with the conditions set forth in the facility's COA. Annual stack testing is conducted for particulate emissions as well as for NOx and SO_2.

NB Power proposes to install a new CEMS as part of the Project in accordance with the appropriate protocols.

Mitigation (Supplementary Control System)

NB Power currently operates a SCS at the CCGS to proactively respond to predicted exceedances in ground level concentrations of SO_2.

NB Power will validate its SCS model following refurbishment in order to ensure that it is acceptably predicting maximum ground level concentrations, as a result of the new fuel and control equipment.

The SCS models the dispersion of SO_2 emissions on a daily basis to predict downwind ground-level concentrations. Based on the actual operating load at the time and a near term forecast of local weather conditions, predictions of the ground level concentration are made and the results are compared with stated objectives. Action is taken to reduce emissions, if needed. The CCGS is operated in this manner to ensure that actual emissions from the CCGS do not result in an exceedance of the ambient standards.

NB Power proposes to continue the operation of this predictive system following the proposed refurbishment.

Ambient Air Quality Monitoring Systems

Currently, several ambient air quality monitoring stations are operated in the Saint John area by the NBDELG and local industry, and Environment Canada. Data from these stations was used to assess existing background and cumulative air quality parameters as described above.

The NBDELG and local industry operate a network of ambient monitors in the Saint John region. This network consists of approximately 12 separate locations, at which the concentrations of various pollutants are measured, including SO_2, NOx, PM, particulate matter with aerodynamic diameter less PM_{10}, and $PM_{2.5}$.

The Environmental Protection Service of Environment Canada also operates several ambient air quality monitors in the Saint John area as part of the NAPS network. These monitors measure a variety of pollutants, including SO_2, NOx, PM_{10} and $PM_{.2.5}$. In most cases, monitoring stations are operated on a co-operative basis with NBDELG.

NB Power currently supports the operation of the provincial acid deposition monitoring network in all of New Brunswick, including southern New Brunswick and the Study Area of interest. Monitoring results from this network are reviewed and presented each year in the annual air quality monitoring report prepared by the NBDELG.

There is an expected reduction in ground-level concentrations associated with emissions from the proposed post refurbishment operation of the CCGS. In addition, an extensive ambient monitoring network in the Saint John area currently exists and is expected to continue operation in the future. Therefore, NB Power's proposed plan is to continue the in-stack CEM and to analyze the data from the existing ambient air quality stations for the purposes of a continuing assessment of air quality issues in the region as they may pertain to the CCGS.

Vehicle Emissions

An assessment of the effect of emissions from vehicle traffic associated with the CCGS was conducted for three phases: existing traffic; construction phase traffic; and traffic during future operations. The assessment was conducted using a US EPA (CALINE4) recommended dispersion model, and was performed for the various roadways of concern, examining the effects of emissions of SO_2, NOx and PM on air quality. CO was also examined; however, the effect on air quality, based on hourly average, was always at least a hundred-fold less than the New Brunswick standard of 35,000 $\mu g/m^3$, and thus is not addressed further herein.

Table 7.18 indicates the vehicle emission factors used, as published by the EPA. The factor for SO_2 is considered to be a conservative number (*i.e.*, larger than actual), since the average sulphur content of gasoline in New Brunswick is less than the average for North America.

TABLE 7.18 Vehicle Emission Factors (US EPA, 1994: EEAI, 2000)

Vehicle Type	SO_2 (g/mile)	NOx (g/mile)	PM (g/mile)
Heavy Duty Diesel Trucks	5	25	1
Passenger Vehicles	1.5	3	0.5

Table 7.19 is an analysis of the traffic counts for the three phases noted, while Table 7.20 indicates the annual emission rates for the three phases discussed.

The modelled effect of traffic emissions for SO_2, NOx, PM, and $PM_{2.5}$ on Air Quality along the various roadways for the three phases of operation are shown in Tables 7.21 – 7.24

The provincial ambient air quality standards are provided for comparison.

The increase in emissions from existing phase through construction to future operation is not substantial. The largest increase is in the emissions of NOx, from the existing phase to construction. This is mainly due to an increase in vehicle traffic associated with worker commuting and material movement to the site. There is little change in the total emissions of SO_2 and PM through the phases, mainly because of changes in vehicle types, and corresponding emissions during the different phases. In general, the contribution of emissions to the airshed from the proposed increased traffic is small.

The predicted maximum ground level concentrations along the road-side were well below the provincial ambient standards for all pollutants, and below the national ambient air quality guideline for $PM_{2.5}$. This is a conservative approach since the analysis assumes that all PM emissions are $PM_{2.5}$.

TABLE 7.19 Traffic Volumes: Average Annual Daily Traffic (AADT)

	Existing			Construction			Future		
Highway Links	Vehicles	HDDTs	Total	Vehicles	HDDTs	Total	Vehicles	HDDTs	Total
King William Road - Coleson Cove to Lorneville Rd	1310	50	1360	2174	80	2254	1427	194	1621
King William Road - Lorneville Rd. to Route 1	4323	242	4565	5187	272	5459	4440	386	4826
Route 1 – King William Rd. to Route 7	6475	525	7000	7339	555	7894	6592	669	7261
Route 1 – Route 7 to Market Place Interchange	21950	750	22700	22726	777	23503	22041	872	22933
Market Place – Route 1 to West Saint John Port	7688	312	8000	7688	312	8000	7688	454	8142
Route 7 – Route 1 to Route 177	11932	969	12900	12018	971	12989	11958	970	12928

Note: Construction traffic estimates reflect the average daily volumes over the construction time frame, not the peak six months.
Vehicles – passenger and light duty trucks
HDDTs – heavy duty diesel trucks

Conditions related to the regular maintenance and efficient operation of trucks during construction and operation will be included in the Project's contracts.

TABLE 7.20 Vehicle Emissions – From CCGS and Future Traffic

Sources of Emissions	SO_2	NOx	PM
Traffic – Existing	108	264	34.0
Traffic – During Construction	114	275	35.6
Traffic – Future (after refurbishment)	112	280	34.8

TABLE 7.21 Predicted Ground Level Concentrations Along Roadway - Sulphur Dioxide

Highway Link	Concentration ($\mu g/m^3$)		
	Existing	Construction	Future
King William Road – Coleson Cove to Lorneville Rd	14	15	15
King William Road – Lorneville Rd. to Route 1	31	32	32
Route 1 - King William Road to Route 7	46	47	47
Route 1 - Route 7 to Market Place Interchange	49	50	50
Market Place – Route 1 to West Saint John Port	39	40	40
Route 7 - Route 1 to Route 177	10	10	10

TABLE 7.22 Predicted Ground Level Concentrations Along Roadway - Nitrogen Oxides (as NO_2)

Highway Link	Concentration ($\mu g/m^3$)		
	Existing	Construction	Future
King William Road – Coleson Cove to Lorneville Rd	32	34	38
King William Road – Lorneville Rd. to Route 1	73	73	76
Route 1 - King William Road to Route 7	109	113	115
Route 1 - Route 7 to Market Place Interchange	111	115	116
Market Place - Route 1 to West Saint John Port	91	92	97
Route 7 - Route 1 to Route 177	23	24	25

TABLE 7.23 Predicted Ground Level Concentrations Along Roadway Particulate Matter

Highway Link	Concentration ($\mu g/m^3$)*		
	Existing	Construction	Future
King William Road – Coleson Cove to Lorneville Rd	2	2	2
King William Road – Lorneville Rd. to Route 1	4	4	4
Route 1 - King William Road to Route 7	6	6	6
Route 1 - Route 7 to Market Place Interchange	6	6	6
Market Place – Route 1 to West Saint John Port	5	5	5
Route 7 – Route 1 to Route 177	1	1	1

Note: *1-hour predictions scaled to 24-hour using the US EPA screening level scaling factor of 0.4

TABLE 7.24 Predicted Ground Level Concentrations Along Roadway ($PM_{2.5}$)

Highway Link	Concentration ($\mu g/m^3$)*		
	Existing	Construction	Future
King William Road – Coleson Cove to Lorneville Rd	2	2	2
King William Road – Lorneville Rd. to Route 1	4	4	4
Route 1 - King William Road to Route 7	6	6	6
Route 1 – Route 7 to Market Place Interchange	6	6	6
Market Place - Route 1 to West Saint John Port	5	5	5
Route 7 – Route 1 to Route 177	1	1	1

Note: *1-hour predictions scaled to 24-hour using the US EPA screening level scaling factor of 0.4

Marine Vessel Emissions

Tanker traffic in the Saint John, New Brunswick area typically offloads cargo at two sites, i) the Irving Terminal (Wharf) located near the Courtenay Bay Generating Station, and ii) the Irving Canaport monobuoy, located approximately 1.2 km offshore at the southeast entrance to the Saint John Harbour. Presently, tankers going to Canaport attach to this buoy and unload their cargo to storage tanks located nearby onshore via an undersea pipeline from the monobuoy to the land-based tanks.

The number of vessels visiting the area to feed the CCGS will change because of the proposed refurbishment. After the Project, the shipments of fuel to the Irving Wharf for Coleson Cove will cease (29 tankers per year). It has been proposed that the shipments of Orimulsion® for the CCGS be delivered to the Canaport monobuoy 14 times per year using larger tankers (150,000 DWT). Thus, there will be a substantial reduction in marine traffic for CCGS, and a corresponding change in emissions from marine vessels (magnitude, frequency, and location).

For the purpose of this EA, the limestone and gypsum have been assumed to be delivered and shipped using Pier 10 at the Port of Saint John using 60,000 DWT bulk carriers. The NB Power related traffic at this pier would consist of 5 deliveries of limestone and 8 outgoing shipments of gypsum each year. Thus, there will be a change in marine traffic, and a corresponding change in emissions from marine vessels (magnitude, frequency, and location) associated with the NB Power operation.

The estimated pollutant emission rates from the tankers and tugboats are presented in Tables 7.25 and 7.26.

Following the refurbishment of the CCGS, the marine emissions in specific areas near the population centers will decrease substantially (approximately 35%). Since the existing emissions are small relative to other sources, and in the future case the emissions near the population center will be substantially reduced, the potential for these emissions to cause adverse effects on air quality is expected to be negligible.

TABLE 7.25 Marine Vessel Emissions – Tankers and Bulk Carriers

	Existing Operations			Post Refurbishment Operations		
	Canaport NB Power	Irving Terminal NB Power	Pier 10 NB Power	Canaport NB Power	Irving Terminal NB Power	Pier 10 NB Power
# of Vessels per year	0	29	0	14	0	13
Average Vessel Size (dwt)	-	40,000	-	150,000		60,000
Vessel Offload-Time (hours)	-	54	-	36	0	54
Total Off-load Time (hours)	0	1,566	0	756	0	702
Total Time Maneuvering (hours)	0	174	0	84	0	78
Total Time Idling (hours)	0	1,392	0	672	0	624
Emissions						
SO_2 (tonnes/year)	0	101.9	0	57.5	0	47.1
NO_x (tonnes/year)	0	101.6	0	56.7	0	46.8
CO (tonnes/year)	0	19.4	0	14.6	0	9.6
PM (tonnes/year)	0	2.7	0	1.6	0	1.3
PM_{10} (tonnes/year)	0	2.2	0	1.3	0	1.0
$PM_{2.5}$ (tonnes/year)	0	1.4	0	0.8	0	0.7
HC (tonnes/year)	0	4.8	0	4.1	0	2.5

Legend: dwt – dead-weight tons

TABLE 7.26 Marine Vessel Emissions – Tugboats

	Existing Operations			Post Refurbishment Operations		
	Irving Terminal NB Power	Canaport NB Power	Pier 10 NB Power	Irving Terminal NB Power	Canaport NB Power	Pier 10 NB Power
Number of Vessels	29	0	0	0	14	13
Number of Tugs	58	0	0	0	28	26
Time in Use Per Tug (h)	4	-	-	-	4	4
Emission Factors						
NO_x (kg/hr)	0.29	-	-	-	0.29	0.29
CO (kg/hr)	0.73	-	-	-	0.73	0.73
THC (kg/hr)	0.38	-	-	-	0.38	0.38
Emissions						
NO_x (tonnes/year)	0.070	0	0	0	0.033	0.030
CO (tonnes/year)	0.17	0	0	0	0.081	0.075
THC (tonnes/year)	0.09	0	0	0	0.043	0.040

7.3 Marine Ecosystem

During operations, the refurbished CCGS will receive Orimulsion® from tankers which transport the fuel to a port facility in the Bay of Fundy. Tanker traffic, as a result of the Refurbishment Project, will be reduced from present frequencies. Nevertheless, accidental spills of Orimulsion® could occur during the transportation and/or offloading associated with the Project.

An accidental spill of Orimulsion® may affect Bay of Fundy biota through direct mortality, habitat degradation or behavioral changes. The Bay of Fundy provides valuable habitat for right whales, a species at risk of extinction. Effects of an Orimulsion® spill could place this species under increased stress. A spill of Orimulsion® could also affect traditional fisheries and aquaculture by reducing the available resource, by fouling fishing gear, vessels and equipment, and by the interruption of harvesting operations.

Orimulsion® has different chemical, physical and toxicological characteristics than that of Fuel Oil #6 (currently used at the CCGS), so that a spill event of Orimulsion® would likely affect the marine ecosystem in a manner different than from a Fuel Oil #6 spill.

7.3.1 Scope of Assessment

The scope of this assessment is based on a spill during the transportation or unloading of Orimulsion® in the Bay of Fundy. The assessment scope consists of a CERA of spills of Orimulsion® and Fuel Oil #6 in the Bay of Fundy and the assessment of the economic consequences to traditional fisheries and aquaculture industries of such an event, both for the short- and long-term. The comparison will provide a distinction between the existing environment (marine transport of Fuel Oil #6) and the proposed Project (marine transport of Orimulsion®).

An extensive existing database and a well-developed set of sophisticated analytical tools already exist to support these studies for both Fuel Oil #6 and Orimulsion®. Where necessary, specific supplemental information has been generated and applied specifically to the marine ecosystem of the Bay of Fundy.

7.3.1.1 Boundaries

The spatial boundary for the CERA study is the Bay of Fundy. This spatial boundary includes offshore and shoreline habitats, as well as islands.

Various agencies and departments have jurisdiction over shipping activities as they relate to oil spills, marine mammals, fish habitat, and other aspects of the marine environment. For example, the *Fisheries Act* governs discharges of any substances deleterious to fish and the *Marine Mammal Protection Act* may apply to particular cases of vessel operation. Other relevant legislation and agreements include Canadian-ratified international agreements (*e.g.*, through the International Maritime Organization (IMO), and the Canada *Shipping Act* (CSA); the *Migratory Birds Convention Act*). The *CSA* specifies the requirements for oil transfer and spill contingency plans for both vessels and shoreside oil handling facilities, as well as inspection programs for foreign vessels entering Canadian waters.

The technical boundaries of the assessment were bounded by the ability to model the movement and dispersion of spills. The assessment did not extend into Chignecto Bay or Minas Basin because CERA model outputs indicated that it was unlikely that a spill of fuel oil or Orimulsion® from selected sites would reach these areas. This was confirmed through a statistical analysis of a 30-year wind record from Saint John Airport (Golder Associates Ltd., 2002).

The temporal boundary for the CERA is the operation life of the CCGS, which is expected to be 25 years after refurbishment is completed.

7.3.1.2 Baseline

The biophysical description of the marine environment, including general hydrology, aquatic and biological environment are described in Section 5.0.

The Project involves converting the CCGS to receive about 14 cargoes of up to 1 million barrels of Orimulsion® by tanker per year. All of these barrels will be discharged at the Canaport Monobuoy owned and operated by Irving Oil Limited.

Orimulsion® tankers will sail to the Canaport Monobuoy from Venezuela via the Bay of Fundy. They will be chartered by NB Power.

It is proposed that Orimulsion® deliveries to Canaport will commence in 2004.

In continuous operation since 1970, Canaport is owned and operated by the Irving Oil organization. It is the Western Hemisphere's first deepwater oil terminal, and is the nearest deepwater harbour/refinery port to US markets able to handle supertanker cargoes.

Description of Existing Vessel Traffic

Historically, there have been approximately 700 vessel arrivals into Port of Saint John, although 2001 saw an increase in ship arrivals to over 1,000 for the year. Coleson Cove related shipments to Courtenay Bay represent 29 vessels per year, or less than 4% of overall harbour traffic.

The Orimulsion® project will result in a significant shift of NB Power related tankship traffic away from Courtenay Bay to Canaport.

Approximately 2,000,000 tons/year of Orimulsion® will be delivered for the CCGS. That plant is currently serviced by fuel oil deliveries at oil handling facilities at Courtenay Bay. Using 150,000 DWT tankships to deliver Orimulsion® to Canaport will result in about 14 deliveries per year. This will displace NB Power tankships calling at Courtenay Bay for the purpose of delivering oil for consumption at the Coleson Cove power plant, approximately 29 deliveries per year.

The Project may also result in new bulk vessel calls at Saint John Harbour for delivery of limestone and removal of gypsum. It is anticipated that approximately 780,000 tons of the combined solid bulk material will be moved annually. Assuming an average bulk ship size of 60,000 DWT, 13 additional vessel arrivals will occur annually at Saint John Harbour, or about 1 additional vessel arrival per month.

The total impact of this project on the density of shipping in Saint John Port (including Canaport) will be as follows:

Annual average vessel arrivals (all ships):	835
Reduction in tankers from Courtenay Bay:	(29)
Increased solid bulk shipments:	13
Increased tanker calls at Canaport:	14
Anticipated annual average arrivals of all ships after Refurbishment:	833

The net result is no significant change in traffic density of shipping in Saint John Port. As previously noted, however, 29 oil tankers will be displaced from within the Harbour and replaced by 14 oil tankers at the Canaport monobuoy approximately 1000 metres off shore.

This will not result in increased environmental risk, based on discussions with the pilots and representatives of the Port, federal authorities and facility owners. There may be a small increase in transit time and potential for delays; however, such an increase can be managed by the Vessel Traffic Management System operated by CCG.

Utilization of Canaport will increase as a result of this project. Under current procedures, a tank vessel leaves anchorage, hooks up to the monobuoy, transfers its cargo, and manoeuvers to clear the limits of the Port of Saint John in an average of 2.0 days. The addition of 14 new vessels will increase the utilization at Canaport from the existing 35% to approximately 42%. This will not result in increased environmental risk, based on discussions with the pilots and representatives of the Port, federal authorities and facility owners. There may be a small increase in transit time and potential for delays; however, such an increase can be managed by the Vessel Traffic Management System operated by CCG.

A LNG terminal is contemplated for the area near the monobuoy that might add approximately 60 - 70 new LNG carrier arrivals annually when the facility is operating a full capacity. These shipments will be new to Saint John Port.

An "exclusion zone" with a radius of about one-half mile (925 m) encircles Canaport, which is put into effect whenever a tankship is moored to the SBM. All vessels, including fishing vessels and their gear, must remain out of the exclusionary zone while a tankship is moored to the SBM.

Vessel movements through the Bay of Fundy and through Saint John Harbour are controlled by rules and regulations issued under the Canada *Shipping Act*. The details are fully documented and available in the Notice to Mariners Annual Edition.

All Orimulsion® shipments will be in accordance with the requirements laid out in the Notices to Mariners including use of existing routes, traffic separation systems, anchorages, call-ins and check points. These procedures already take into account all navigation risks. Canadian Coast Guard's Marine Communications and Traffic Services (MCTS) at Saint John is a key component of the vessel management system in the Bay of Fundy and Port of Saint John.

Typical Orimulsion® Vessel Specifications

As stated previously, Orimulsion® tankers will typically be the the Suezmax-class, which are tankers in the 140,000 - 160,000 dwt size capable of delivering up to one million barrels of liquid cargo.

All tankers for Orimulsion® delivery will be chartered by NB Power. No tankers will be accepted to transport Orimulsion® unless the vessel meets International and National shipping standards. As well, the vessels chartered by NB Power for Orimulsion® delivery will meet Bitor committed standards before loading Orimulsion® in Jose and will meet IOL committed standards before unloading Orimulsion® at Canaport.

Following project approval, and prior to first delivery, detailed operating procedures for the unloading of Orimulsion® at Canaport will be developed and will be available.

Risk Management & Mitigation Strategies

This section contains an assessment of the risks of increasing the volume of petroleum product into Saint John, NB in light of a proposed shift from the use of heavy fuel oil to the use of Orimulsion® as fuel for the CCGS. Orimulsion® destined for Coleson Cove will be offloaded in the Port of Saint John at Canaport, the SBM buoy offshore from Saint John Port operated by IOL.

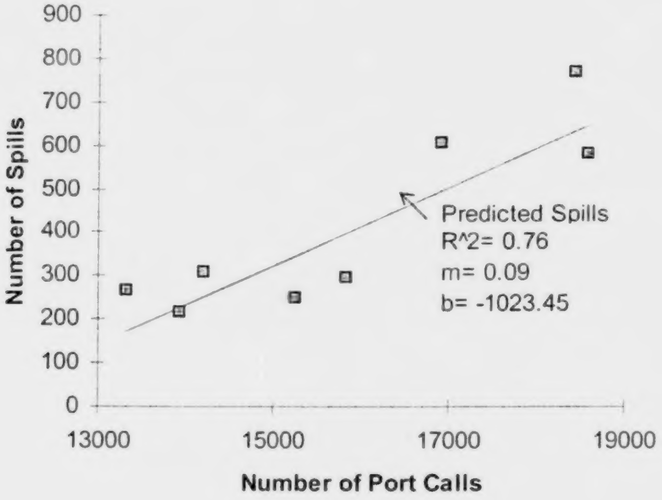
Data for this assessment were drawn from the Government of Canada's Annual Report of the Ship-source Oil Pollution Fund (SOPF), 1999-2000, supplemented by the US Coast Guard's Pollution Incident Reporting System (PIRS) and the Annual Report of the International Oil Pollution Compensation Fund, 2000. Vessel data for the current fleet of tank ships used to transport heavy fuel oil to the Port of Saint John and other vessels operating in the Bay of Fundy were collected from Clarkson's Tanker Register, data maintained by the Saint John Port Authority, and NB Power. Data on heavy fuel oil vessel deliveries at Courtenay Bay in Saint John Port were provided by NB Power. Bitor America provided information for the analysis of the proposed Orimulsion® fleet. Additional references used in the risk analysis are noted in the body of the CERA report.

The Canadian spill data have been combined with US spill data to create a North American spill database to analyze the potential for spills that may occur from this Project. There is no indication that the spill rate in the US is any different than in Canada; however, the larger sample provides a more statistically viable analysis.

7.3.2 Tankship Spill Probability

An analysis of the relationship between the number of port calls and the number of tanker oil spills (during transfer and transit operations) during the 1976-1990 period indicates a strong positive correlation between the two variables (Table 7.27).

TABLE 7.27 Relationship Between Tankship Port Calls and Oil Spills 1976-1990



Source: Analysis of Corbett & Holt Vessel Oil Spill Database and Lloyd's Voyage Records

Given the high degree of correlation between tankship port calls and tankship spill frequency, the number of port calls is an effective means for predicting future spill events.[1]

Using tank ship port calls as a predictor of spill events, the annual rate of spills that have occurred was examined as a function of the annual number of port calls by tank vessels.[2]

Spills larger than 1,000 barrels were selected for analysis in this study. Spills in this size category tend to be reported more accurately and with greater detail, allowing for a more complete analysis.

The number of tank vessel port calls to North American ports averages about 16,000 per year[1]. The annual number of spills in North American waters equal to or greater than 1,000 barrels from tankships in transit during the period of analysis averages about 1.5. This results in a frequency of spills equal to or greater than 1,000 barrels of 1×10^{-4}.

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[1] Corbett & Holt analysis of Lloyd's *Voyage Records* for 1976 through 1990.

[2] Because of the few number of spills in Canadian waters and the unavailability of port call data, data for the US were selected as a proxy for Canadian spills.

7.3.3 Spill Risk Probability of Orimulsion® and Heavy Fuel Oil

Under current plans, NB Power plans to switch from heavy fuel oil to Orimulsion® as a fuel of choice for the CCGS. These plans have been estimated to increase the volume of product shipped through Saint John Port and reduce the number of port calls by using larger tank ships to transport Orimulsion®.

During the period 1998 to 2001, there were on average 29 shipments of heavy fuel oil per year to the Irving Oil terminal in Courtenay Bay for further transport to CCGS, bringing about 1 million tonnes of heavy fuel oil into the Port. Each delivery averaged slightly over 200,000 barrels or about 30,000 tonnes. In 2001, the number of annual deliveries rose to 34, following two years of about 24 deliveries per year.

The fleet used during this period consisted of seventeen tankships. The vessels used were typically single-hull tankships, but five, or about 29%, were of double hull construction. The five double-hulled ships made six port calls during the study period, or 5%. The fleet consists of vessels which ranged in age from 24 years at the time of the call at Saint John Port to new construction for an average age of about 16.5 years. Ships' sizes ranged from 18,288 gross tons to 32,607 gross tons. The cargo carrying capacity ranged from 32,000 deadweight tons DWT to 55,400 DWT , with an average size of about 36,000 DWT .

The volume of NB Power shipments to Saint John Port would double, from 1 million tonnes to 2 million tonnes, if the conversion to Orimulsion® were executed (Table 7.28). However, the use of larger tankships (150,000 DWT for Canaport deliveries of Orimulsion® compared to existing 36,000 DWT at Courtenay Bay) will result in about one-half the number of port calls (29 average annual calls at Courtenay Bay of heavy fuel oil compared to 14 annual calls for Canaport for deliveries of Orimulsion®).

TABLE 7.28 Summary Table of Orimulsion® Vessel Characteristics required by Bitor at Loading Port

	Existing HFO Fleet	Orimulsion® Fleet
Size (deadweight tons)	36,000	150,000
Hull Construction	Mostly Single Hull	Double Hull
Age (mean years)	16.5	7.51
Officer Language Requirements	No requirement	English speaking and crew's mother tongue
No. of Tanks	12	12
Tank Size (m^3)	3,000	12,500
Classification Society	No limitation	IACS Member
Pollution Liability Insurance[2]	$500 million	$1 billion

Notes:

The mean age of Orimulsion® tankers is based on an estimation of the normal distribution of tankersbetween new construction and 15 years, the maximum age of tankers used by Bitor for Orimulsion® deliveries.

Currently, insurance amount is a function of the vessel size and is available through the normal vessel liability insurance provided by the Protection and Indemnification Clubs.

The proposed vessels to be used for the transport of Orimulsion® are to be younger and larger than the vessels currently being used for heavy fuel oil transport to Courtenay Bay. Orimulsion® tankers will also be of double hull construction, as opposed to primarily single hull construction for vessels in current fuel oil trade. Additional fleet characteristics of vessels proposed by Bitor, as risk reduction measures, will be explained in a latter sub section herein.

7.3.4 Risk Control Factors for Orimulsion®

7.3.4.1 Vessel Factors

There are a number of risk management tools that will be employed to reduce the risk of transporting Orimulsion® to Saint John Port. The following are those risk management tools relating to the ships that will be used to transport Orimulsion®:

Vessel Selection Criteria

Vessels are to be chosen through the use of a "vetting" system (see Section 4) based on criteria determined by Bitor at the loading SBM and by IOL at the unloading SBM to ensure careful selection of vessels, crews, and operators. The intent of this selection process is to ensure that vessels are chosen for charter meet or exceed international standards. One such criterion that will be employed is the use of the Mackenzie rating system.

Double Hulls

Only double-hulled vessels will be used for deliveries of Orimulsion®. Tank ships of the size to be used in this trade that are equipped with double hulls have been found to reduce spills from groundings by 90% and from collision by 29% (1990 Det Norske Veritas (DnV) study "Comparative Study on Potential Oil Spill in Collision and/or Grounding").

Crew and Operator Selection

Bitor has indicated a commitment to high standards of training for crewmembers of vessels at their loading terminal. This commitment can contribute significantly to minimizing spills resulting from human error. Studies have revealed that from 75 to 90% of significant incidents can be attributed to human error. Of the 29 tankship spills reported by the Ship-source Oil Pollution Fund, personnel error was cited as the primary cause in 21 of them (72%).

Additionally, Bitor requires that officers selected for Orimulsion® tankers at the Load Port must be orally proficient in both English and the mother tongue of the predominant crew nationality. There is no such requirement for this provision, but the ability to communicate with the crew in an emergency is a potentially important risk reduction tool.

Vessel Age

The screening of ships using a vetting system and the commitment that ships in the Orimulsion® trade to the Port of Saint John be equipped with double hulls will have the effect of removing some older ships from trade in the Bay of Fundy and the Port of Saint John. Bitor has committed at the loading terminal to using vessels less than fifteen years old. Based on a normal distribution of tankers between new construction and 15 years, the average age of Orimulsion® vessels will be 7.5 years, compared to the existing NB Power fleet average age of 16.5 years old.

7.3.4.2 Cumulative Impact On Spill Probability

This section addresses the effects of Bitor's safety measures on potential future spills of Orimulsion®.

7.3.4.3 Base Case

A base case was developed to determine the spill risk that currently exists with the delivery of heavy fuel oil to Saint John Port and the spill risk that might exist with shipments of Orimulsion®. It is assumed that all of the shipments of heavy fuel oil into Courtenay Bay for NB Power will be displaced by the shipments of Orimulsion® to Canaport. The additional safety and prevention measures in excess of current regulatory requirements proposed for use in the Project have not been included in this stage of the analysis.

Two scenarios have been assumed:

- Heavy fuel oil is projected to be transported to the Port of Saint John in vessels and volumes similar to the 1998-2000 annual average (approximately 1 million tonnes with 29 port calls)
- Orimulsion® is projected to be transported to the Port of Saint John and offloaded at Canaport at annual volumes of approximately 2 million tonnes with 14 annual port calls.

Using the previously determined probability of 1×10^{-4} spills per port call for spills equal to or greater than 1,000 barrels, the probability of such a spill of heavy fuel oil at Courtenay Bay is 0.0027 per year. The probability of a spill of Orimulsion® at Canaport is 0.0014 per year.

Using a spill rate of 1×10^{-4} spills in excess of 1,000 barrels per port call, the quantitative effect of some of the risk management tools can be established to determine the overall effect on the probability of a spill of Orimulsion® compared to a heavy fuel oil.

Based on a literature review conducted for this analysis, it has been determined that the use of double hulled tankships is the only risk management tool for which the reduction in risk can be quantitatively determined. The effect of the other risk management tools on the transportation of Orimulsion® in lieu of heavy fuel oil will be assessed by qualitative means.

Based on the analysis of the PIRS and SOPF data and international spill data from the Oil Spill Intelligence Report, it is estimated that groundings account for roughly 60% of the spills in excess of 1,000 barrels from tankers underway and collisions for about 40%. Neither fire/explosion nor structural failure is considered here since they tend to be random, extremely infrequent events that largely defy quantitative prediction. These types of incidents will, however, be addressed in the qualitative assessment of tankship age as a risk reduction factor.

The use of double-hulled vessels for all deliveries of Orimulsion® would result in a significant reduction in the risk of a spill as a result of a grounding and some reduction in the risk of a spill as a result of a collision. Double hulls have been found to reduce spill frequency resulting from "low energy" groundings by about 90% and from collision by about 29% for ships comparably sized to those anticipated to be used for carrying Orimulsion® (1990 DnV study "Comparative Study on Potential Oil Spill in Collision and/or Grounding").

Beginning with an estimated spill probability of 1 X 10^{-4} spills per port call, or 1 spill in excess of 1,000 barrels for every 10,000 port calls, double hulls reduce the probability of a spill from grounding by 90% and from collision by 29%.

The adjusted probability derived from using double hulls alone is 3.4 X 10^{-5} or about 1 spill in excess of 1,000 barrels every 30,000 port calls. Allowing that 5% of the current fleet bringing heavy fuel oil to Saint John Port is double hull, the risk reduction is still in excess of 2.75 times.

Applying these spill probabilities to the current level of heavy fuel oil shipments and the proposed level of Orimulsion® shipments yields a probable spill frequency. In the case of heavy fuel oil shipments to Courtenay Bay, assuming 29 port calls per year, the spill frequency is 1 spill every 370 years based on a probability of 1 X 10^{-4}. In the case of Orimulsion®, assuming 14 port calls per year at Canaport, the resulting spill frequency is 1 spill in excess of 1,000 barrels every 2,100 years.

7.3.5 Impact on Spill Size

While this analysis has focused on spill probability, the Orimulsion® Project will have a potential effect on the size of a spill that may occur. Intuitively, it would appear that the larger ship sizes being used for delivering Orimulsion® to Saint John Port will result in potentially larger spills. In fact, analysis of the relationship between spill size and ship size shows little correlation between the two.

In addition, the beneficial effect that double hull tankships provide to spill probability extends to spill volume as well. The design of double hull tankers means that the amount of oil that may be released in the event of a grounding particularly, will be reduced due to the additional space in the area between the two hulls for oil to migrate if the inner hull is ruptured.

7.3.6 Qualitative Assessment of Risk Management Tools

In addition to those risk management tools for which some quantifiable impact on spill probability may be assessed, several of the risk management tools will have an effect on reducing risk, even though that effect may not be quantitatively expressed.

Ship Vetting - the Coast Guard has determined that many vessel incidents occur on substandard ships. Consequently, any practice that minimizes the presence of substandard ships will reduce the probability of an incident and an oil spill resulting from an incident.

Vessel Age - reducing the age of vessels in a trade will potentially reduce the likelihood of a spill resulting from structural or hull failure. Newer ships tend to be better maintained, although there are excellent ships in service that are older even than the average age of vessels used in the current heavy fuel oil trade to the Port of Saint John. Using a maximum vessel age of 15 years, as proposed by Bitor for the load port, will have the effect of eliminating a potential source of incident risk.

Officer Language Requirements - anecdotally, it has been determined that language barriers can contribute to incidents. The ability of officers to communicate effectively with crewmembers in the time of an emergency may remove a link in the "accident chain" that leads to many incidents.

Classification Society Selection - Currently, the International Association of Classification Societies (IACS) has developed high standards for its members to follow in providing inspection and certification services that represent industry "best practices." The Classification Society prescribes rules for the design and construction of ships, oversees the construction, and periodically inspects the ship during its service.

Since the mid-90s, the US Coast Guard has tracked the performance of Classification Societies as a result of its Port State Control Activities and determined that there is an important correlation between the quality of a ship (particularly relating to accident prevention) and the Classification Society in which the ship is enrolled. Generally, ships enrolled with members of IACS have better performance statistics than other ships.[1]

Bitor has committed to using only vessels classed by members of IACS, at the load port, that will serve to ensure high quality ships in the Orimulsion® trade to Saint John Port.

Cargo Flammability- Whilst fire or explosion from tankships is not a leading cause of oil spill incidents, this type of incident does occur and results in, oftentimes, catastrophic releases of oil. The most noteworthy in recent times was the Mega Borg in 1993 in the US Gulf of Mexico that resulted in the loss of over 14,000 tonnes.

Orimulsion® is a non-flammable cargo. It is comprised of 70% bitumen and about 30% water, which renders it effectively incapable of sustaining a fire. It has a vapour pressure similar to that of water, which makes it non-explosive. Consequently, the potential for a release, as a result of a cargo fire or explosion in the case of an Orimulsion® tanker, is virtually non-existent.

While the effect of these management practices has not been quantified, they all contribute to a further reduction in spill risk from that computed for Orimulsion® shipments.

Transfer Operations: As noted previously, some 70% of tanker spills are associated with equipment failure and of these most occur during transfer operations, the process of loading cargo onto a ship or off loading cargo from a ship. While these spills tend to be small, they are frequent enough to warrant consideration.

Transport Canada has established regulations under the Canada *Shipping Act* governing the handling of cargo during transfer operations, including pre- and post-transfer procedures, equipment standards, and personnel requirements. In addition to these regulations, Irving Oil has established procedures and practices to be used during the transfer of oil at Canaport that will be followed during the transfer of Orimulsion®.

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[1] "2001 Classification Society Performance Statistics," US Coast Guard Port State Control Program, June 2001.

7.3.6.1 Likely Future Condition

The Bay of Fundy ecosystem is affected by a variety of sources, including fishing, possible climate change, and industrial activity. Aquaculture is likely to continue developing, as is industry and ecotourism.

Major efforts are under way to continue to protect the Bay in light of these developments. Special efforts are focused on species at risk, such as the right whale.

NB Power will continue to work cooperatively with the various stakeholders to achieve the goal of protection of the Bay.

7.3.7 Effects Assessment

The effects assessment for the marine ecosystem is based on a CERA, as required in the *Guidelines for an Environmental Impact Assessment, Coleson Cove Generating Station Refurbishment* issued by the Minister of the Environment and Local Government for the Province of New Brunswick on January 15, 2002. The following sections are based on the document: Comparative Ecological Risk Assessment of Spills of Orimulsion® or Fuel Oil #6 in the Bay of Fundy, prepared by Golder Associates Ltd.

7.3.7.1 Comparative Ecological Risk Assessment

Golder Associates Inc. (Golder 2002a) conducted a comparative ecological risk assessment of accidental Orimulsion® and Fuel Oil #6 spills in the Bay of Fundy in support of the EA process to refurbish this Generating Station from Fuel Oil #6 to Orimulsion®. The economic consequences of hypothetical spills of Orimulsion® and Fuel Oil #6 were also considered. The CCGS is located near Lorneville, St. John County, in Southern New Brunswick.

Orimulsion® is a bitumen-based fuel being transported and used worldwide as an alternative fuel for power plant electric generation. Based on the increased use of Orimulsion® in electric power production, a significant effort has been devoted to research on the potential fate and effects of accidental marine spills of this fuel. Orimulsion® is produced in Venezuela by Bitúmenes Orinoco S.A. (Bitor), a Petróleos de Venezuela (PDVSA) company, and has been transported to North America, Europe, and Asia since 1991. Because of the effective spill-prevention practices used by Bitor, in the past 10 years, over 300 million barrels of Orimulsion® have been safely shipped worldwide.

An ecological risk assessment is the scientifically based, systematic evaluation of potential risks to ecological systems from a human activity. Risk is defined as a combination of the likelihood of an event occurring and the consequences of that event. Ecological risks are further characterized in terms of the exposure of ecological systems or natural resources to a stressor, such as toxic chemicals, and the resulting ecological effects of that stressor on specified species, habitats, or other VECs.

For an ecological risk to exist, two conditions must be satisfied:

1. The stressor must be hazardous (*i.e.*, have the inherent ability to cause adverse effects), and
2. The stressor must contact or be exposed to an ecological component (*e.g.*, a species, biotic community, habitat) for both sufficient intensity and duration to cause an adverse effect.

A CERA addresses ecological risks from two alternative potential stressors in a side-by-side comparison to evaluate whether the risk from one stressor is greater than, equal to, or less than the risk from the other stressor. The objective of this study was to address directly and in a scientifically defensible manner the real or perceived ecological risks concerning Orimulsion® transport and potential spills in the Bay of Fundy compared to Fuel Oil #6. Thus, the central question is whether conversion of the CCGS to Orimulsion® would result in ecological risks from spills that are the same as, less than, or greater than the risks from Fuel Oil #6. The entire CERA is aimed at answering that one question.

The fate of the Orimulsion® and Fuel Oil #6 components was modeled using an environmental fate and transport model [SIMAP, developed by Applied Science Associates (ASA)]. Maps of environmental exposures to sensitive or important species/habitats (VECs) resulting from adverse spill cases, from within a suite of plausible adverse scenarios, were developed. The exposure or concentration maps produced by the model showed the spill distributions across important habitats of the Bay of Fundy, the cumulative water exposures, and shoreline oiling. The analyses were paired outputs, allowing the direct comparison of the ecological consequences of spills of Fuel Oil #6 or Orimulsion®. This provided the quantitative and scientific basis for answering the comparative risk questions about Orimulsion® transport in the Bay of Fundy.

Characteristics Of Orimulsion®

Orimulsion® is a mixture of approximately 70% natural bitumen, 30% water, and <0.2% surfactant package. Orimulsion® is an emulsion of natural bitumen particles in water; the emulsion of bitumen particles is maintained through the use of a surfactant (alcohol ethoxylates) and an emulsion stabilizer (monoethanolamine). Research carried out at numerous research centers, laboratories, and universities worldwide indicate that should an accidental spill of Orimulsion® occur in the marine environment, Orimulsion® will initially dilute in the upper few meters of the water column as a dispersion of bitumen particles, dissolved polynuclear aromatic hydrocarbons (PAHs), and surfactant. Extensive research has been carried out on the chemical and physical characteristics of Orimulsion® as well as its potential ecological effects.

Under most circumstances, exposure to Orimulsion® components presents a lower ecological risk than Fuel Oil #6, primarily because of the lower PAH content in Orimulsion®. PAHs are considered the primary factor producing acute toxicity of fuels in the water column. Research and modeling efforts to date indicate that following an Orimulsion® spill at sea the majority of the bitumen will be initially dispersed in the water column, and that significant amounts of bitumen will not surface. This behaviour is also expected to significantly reduce the risk of oiling to water birds following an accidental Orimulsion® spill, as compared to the risk of typical floating oils. The much lower mass of surfaced bitumen from Orimulsion® compared to the almost complete surfacing of Fuel Oil #6 also means there will be much less coating of shorelines and aquaculture facilities from Orimulsion®, very significantly reducing the ecological risks.

Chemical Properties

The chemical composition of the natural bitumen in Orimulsion® reflects its highly degraded nature. The chemical characteristics of Orimulsion® have been evaluated by Environment Canada (Jokuty *et al.*, 1999 and Wang, 2002a) and Battelle (1998), among others.

One drum of Orimulsion® was provided by NB Power's Dalhousie Generating Station for use and evaluation as part of this CERA. This Orimulsion® was chemically analyzed by Environment Canada, and was provided to Environment Canada's Toxicology Laboratories in Moncton, New Brunswick, and Golder's HydroQual Toxicology Laboratories in Calgary, Alberta, for development of environmental toxicology data.

According to Battelle (1998), the chemical composition of Orimulsion® is remarkably consistent, which contrasts significantly from the highly variable chemical composition of Fuel Oil #6 (Lewis, 2002). It is notable that the concentrations of PAHs are relatively low in Orimulsion®, as compared to other fuel oils (USCG, 1997). PAHs are of interest because of their potential acute toxicity when released into the aquatic environment.

Physical Properties

Physical properties of Orimulsion® were evaluated and described by Environment Canada (Jokuty et al., 1999) and Battelle (1998). The pour point of fresh Orimulsion® is low at approximately 3 degrees Celsius (°C). The flash point is high (>95°C); in reality, the water content of Orimulsion® (30%) would prevent spontaneous ignition of the fuel (Jokuty et al., 1999). Furthermore, the bitumen component undergoes very little evaporation, thus precluding the build-up of ignitable fumes. Almost all of the evaporation from Orimulsion® would occur from the water component of the fuel.

The density of Orimulsion® and bitumen is intermediate between freshwater and seawater and is affected by temperature. The bitumen in Orimulsion® has an API gravity that ranges in value from 7.8 to 9.3 (specific gravity 1.01 to 1.02).

Spill Scenario Development Process

The spill scenario development process was initiated with the Scenario Development Workshop held by Golder in Saint John, New Brunswick, on October 31, 2001. The stated objective of this Workshop was to reach consensus on an initial set of working spill scenarios for the CERA. In particular, the following parameters were defined: 1) spill location, 2) volume/mass, 3) depth of release, and 4) duration of release.

Issues related to plausibility of spills, such as the frequency and nature of shipping accidents, shipping traffic in the Bay of Fundy and Saint John Harbour, shipping vessel parameters, fuel volumes anticipated per shipment, and fuel offloading sites were considered and discussed.

The Spill Scenario Workshop brought to bear a host of considerations in selecting the initial conditions for analysis in this ecological risk assessment. Workshop participants included representatives from Saint John Pilots, DFO, Transport Canada-Marine Safety, Atlantic Pilotage Association, Marine Communications and Traffic Services-Saint John, Saint John Port Authority, New Brunswick Department of Environment and Local Government, Alert Inc., Environment Canada, CCG, and Atlantic Coastal Action Program.

Based on discussions held, seven spill scenarios were defined for evaluation as part of this CERA.

Overview of SIMAP HYDRODYNAMIC Model And Environmental Data Inputs

ASA's boundary-fitted coordinate hydrodynamic model (BYHYDRO) was used to generate the applicable hydrodynamic data sets suitable for use in the SIMAP model system. The model's governing equations were described in detail in Muin and Spaulding (1997a, 1997b) and Spaulding, *et al.* (1999). The SIMAP hydrodynamic model uses a variety of inputs including tidal, river flow, and wind-driven currents and hourly wind speed, wind direction, etc., for the time of the spill simulation. Input from national and regional experts was obtained through the Hydrodynamic and Modeling Workgroup session carried out as part of the Conceptual Model Workshops held in Saint John, New Brunswick, on November 1, 2001.

For the stochastic analysis, a long-term (30-year) wind record was sampled at random to develop a probability distribution of environmental conditions that might occur at the time of a spill. Surface water temperature varies over an annual cycle. Means for the Bay of Fundy are 0 to 14°C in the surface water (<12 m) and 1 to 12°C in deep water, based on data in Greenberg et al. (1996). Salinity in the Bay of Fundy is about 32 parts per thousand (ppt) (Greenberg *et al.*, 1996). In the lower Saint John River (from just above the Reversing Falls) and Harbour the salinity ranges from 17 to 25 ppt (WGA, 1996).

Overview of SIMAP Fate and Transport Processes

The physical fates model estimates the distribution of oil and fuel components (as mass and concentrations) on the water surface, on shorelines, in the water column, and in the sediments. The model is three-dimensional, using a latitude-longitude grid for environmental and geographical data. Algorithms based on state-of-the-art published research include spreading, evaporation, transport, dispersion, emulsification, entrainment, dissolution, volatilization, partitioning, sedimentation, and degradation.

Oils are lighter than water at the time they are spilled. If spilled on the surface, they spread as slicks. If released under water, oil droplets are formed, which surface rapidly because of the buoyancy of the oil relative to water. The surface oil is transported large distances by wind and currents, oiling surface-dwelling wildlife and shoreline habitats. Oil may be entrained into the water by high winds and other sources of turbulence. Surface oil may also be entrained by chemical dispersants as a part of response activities. Entrained droplets may adsorb to suspended sediments and settle to the bottom due to the higher density of the combined material. This occurs most commonly in shallow waters with high wave activity. In addition to these processes, the model simulates dissolution of the toxic aromatic components from the entrained droplets and the fate of these aromatics in the water column and sediments. Orimulsion®, because it is an emulsion of bitumen in water, readily disperses into the water column when it is spilled, as opposed to forming a surface slick as do typical floating oils. Thus, Orimulsion® is initialized in the model as dispersed (bitumen) droplets in water.

Conceptual Model And Valued Environmental Component Selection

The selection of VECs began with the Conceptual Model Workshop held in Saint John on November 1, 2001. One of the outcomes of the Workshop was a draft list of selected VECs using the following criteria:

- Societal importance,
- Ecological importance,
- Threatened or endangered status,
- Modes of exposure (via water column, sediment, surface slick), and
- Knowledge about the species.

Following the Workshop, the study team carried out additional literature investigations and made inquiries among local and regional experts to confirm the appropriateness of the VEC selection. An effort was made to select VECs from among the major floral and faunal groups (*i.e.*, marine mammals, seabirds, shorebirds, fish, invertebrates, shellfish, and plants). In addition, the VEC selection was cross-referenced with valued habitats to ensure that there were representatives of species inhabiting critical habitats within the Study Area.

The selected VECs represent a wide variety of plant and animal groups that are of ecological and social importance. VECs are also represented in all of the primary habitat types in the Bay of Fundy. Because of the variety of habitats and food habits, the primary pathways for exposure to accidental spills of Fuel Oil #6 or Orimulsion® are accounted for. These primary exposure pathways are the water column, the sediments, and surface slicks/tar balls. In this classification, "sediments" includes shoreline substrate (*e.g.*, mudflats) as well as offshore bottom sediments.

The toxicity of Orimulsion® and Fuel Oil #6 has been tested on a range of organisms worldwide, including Bay of Fundy species such as salmon, amphipods, and seaweed. This data set is broad enough to provide either direct or surrogate toxicity data for the VECs. The CERA report (Golder 2002a) summarizes the available toxicity data for Orimulsion®. If data were not available for a VEC, the species that was most closely related and/or most sensitive was selected as the surrogate for that species.

Geographic Areas of Concern

The Bay of Fundy is a very complex system. It contains hundreds of important habitat areas that provide food, breeding grounds and shelter for a large number of plant and animal species. It was not possible to provide a detailed evaluation of risks from spills of the two fuels to every habitat area in the Bay. Therefore, two levels of analysis were conducted: (1) Bay-wide and (2) geographic areas of concern (GACs).

The Bay-wide analysis dealt with large-scale predictions of Fuel Oil #6 or Orimulsion® concentrations in the water column and along the coastline of the Bay. The large-scale information was useful in terms of comparing the overall extent of potential effects from the two fuels. In addition, this large-scale analysis was the only way to assess risks to wide-ranging species (such as seabirds).

The GAC analysis allowed the ecological risk assessment to focus on specific areas of the Bay of Fundy. Many of the shoreline GACs are adjacent to important off-shore habitat. GACs were identified along the coastlines of New Brunswick and Nova Scotia to represent important habitat and species assemblages. The idea for the use of GACs arose from the Conceptual Model Workshop held on November 1, 2001, in Saint John, New Brunswick. During the Workshop, a number of participants emphasized that the conceptual model must include valued habitats as well as valued species. The use of GACs allowed a more detailed assessment of risks to particular habitat types and the VECs that use those habitats. The GACs were chosen using the following criteria and information sources:

- Importance to endangered and threatened species and species of interest;
- Shellfish harvesting area;
- Plant harvesting area (rockweed, dulse);
- Spawning habitat (fish);
- Listed as an "Important Bird Area (IBA)" by the Canadian IBA Program or known to be important seabird or shorebird habitat;
- Importance as habitat to marine mammals;
- Listed as an existing or proposed Protected Area or Park (National, Provincial/ Regional);
- Location for aquaculture, fish weirs, or lobster pounds; and
- Recognized as an important area for human recreational use and/or historic significance.

Included in the GACs are aquaculture areas, such as aquaculture leases, fish weirs, and lobster pounds. Eighteen GACs were selected after reviewing resource maps produced by Eastern Charlotte Waterways (ECW, 2002), DFO, and Environment Canada. Sources of data on seabird distribution included information from the Canadian Important Bird Area (IBA) program, the ECW (ECW, 2002) and Environment Canada. Additional data sources on seabird distribution in the project area, not used by the CERA are available from the CWS of Environment Canada. This information would not change the fundamental conclusions of the CERA and will be available for contingency planning purposes.

The GACs also represent a full range of shoreline habitat types. The GACs were selected to represent the "first hit" locations (*e.g.*, the mouth of Annapolis Basin) or locations representing several over-lapping resource locations (*e.g.*, off the eastern shore of Deer Island). GACs were simplified to facilitate the comparisons of model predictions for the hypothetical spills of both fuels.

The CERA conducted for the Bay of Fundy addressed one primary question, are the risks of an Orimulsion® spill greater than, similar, or lower than Fuel Oil #6.

As is the case with any complex risk assessment, a level of uncertainty, including that associated with the potential toxicological effects on adult seabirds and eggs remains in the understanding of the ecological risks from spills of these two fuels (see Section 6.3 of the CERA report). The weight of evidence however, shows that Orimulsion® likely presents a lower toxicological risk to seabirds that Fuel Oil #6. Therefore, the basis for confidence in the final answer to the primary risk question is scientifically sound based on the following:

First, this is a comparative risk assessment, so many of the uncertainties associated with one fuel type exist for the other fuel type, and so long as the two situations are treated in an unbiased manner, the comparison results should be accurate in spite of these uncertainties. Second, the results from the comparative risk assessments are quite clear because the risks from these two fuels are so different: for example, consider the four routes of exposure for bird: effects: physical oiling, ingestion of fuels during preening, inhalation of volatile toxics, and the potential exposures of materials carried by the adult to eggs.

Since there is an order-of-magnitude difference between the two fuels in the mass of fuel that surfaces after a spill, the relative risk of oiling of birds differs by a factor of 10 (10 times lower for Orimulsion®). A further difference is added by the lower level of oiling of birds exposed to surfaced bitumen compared with a slick from Fuel Oil #6, and the fact that the bitumen tar ball contamination will be superficial as compared to the wicking effect of heavy fuel oils. Furthermore, the acute toxic effects on adult birds from ingestion of surfaced fuels differs by another order-of-magnitude in the inherent toxicity of the material with respect to PAHs and other toxic constituents. In all cases the exposure to Orimulsion® components is lower. Moreover, the inhalation risk from Fuel Oil No. #6 is much greater than Orimulsion® because of the essential absence of volatiles in surfaced bitumen.

Regarding exposure to eggs, this would be much lower for Orimulsion® since there is much less material on the water surface, covering a much smaller surface area of the Bay, and the bitumen tar balls that do surface are much less likely to stick to the adult for transport to the eggs. Further, the surfactant in Orimulsion®, which potentially could be a risk for bird eggs, does not surface with the bitumen but remains dissolved in low concentrations in the water column, virtually eliminating this exposure route from adults to eggs.

In addition to these direct ecological risks to birds, for which the CERA focused on oiling effects as being of greatest concern, the potential risks from food-chain effects were also addressed (through toxicity and exposure studies of diatoms and *Corophium*). The case of the ecological risks to birds being so much larger for Fuel Oil #6 than Orimulsion®, is just one among many others that were discussed in the CERA where the difference in ecological risks to VECs between the two fuels far exceeds the magnitude of potential uncertainties in this comparative assessment.

Conclusions

Based on the analyses conducted and reported as part of this CERA, the ecological risks to the Bay of Fundy ecosystems and VECs from spills of Orimulsion® were found to be significantly lower than the existing risks of spills from Fuel Oil #6. This conclusion is supported by the following comparative scientific findings.

First, Orimulsion® is derived from geological deposits that have become highly weathered over literally hundreds of millions of years. Chemical analysis conducted by Environment Canada (Wang, 2002a) document the weathered nature of the bitumen used in Orimulsion®. These chemical analyses show that the more volatile toxic constituents of these bitumen deposits [*e.g.*, PAHs and benzene, toluene, ethylbenzene, and xylene (BTEX) compounds] have long been degraded. French (2000) compiled and reviewed acute toxicity data on petroleum hydrocarbons and found that PAHs, C3-benzenes, and BTEX components of heavy fuel oils are the primary cause of the acute toxicity associated with heavy fuel oil spills in the water column. Based on the acute toxicity and analytical data developed for Orimulsion®, and presented in Chapter 3.0 of this report, PAHs appear to be the primary mode of acute toxicity for Orimulsion®. It is also important to note that Orimulsion® is produced using a single source of bitumen (Cerro Negro bitumen), by one company (PDVSA-BITOR), using the same process. This results in a very chemically consistent product, as documented by Environment Canada (Jokuty *et al.*, 1999 and Wang, 2002a) and Battelle (1998).

In contrast, Fuel Oil #6 can have high concentrations of the lighter-end PAHs and BTEX, and these concentrations can be quite variable, depending on the source of the heavy fuel oil and blending of additives (Lewis, 2002). The data developed by Environment Canada for samples of Fuel Oil #6 currently being used at the CCGS show that these heavy fuel oils contain one to two orders-of-magnitude higher concentrations of PAH and other toxic constituents than the bitumen of Orimulsion® (Wang, 2001 and Wang, 2002b). Acute toxicity data developed using Fuel Oil #6 samples from Coleson Cove show that Orimulsion® is less toxic than heavy fuel oils.

However, the ecological risks associated with these two fuels are more complicated than that. While there are much lower concentrations of toxic constituents in Orimulsion® than in Fuel Oil #6, the constituents present in Orimulsion® are potentially more readily available to be released into the water column because they are primarily in the aqueous phase of the emulsion. Consequently, these toxic constituents in Orimulsion® will be released into the water column following a spill, regardless of the physical conditions at the time of the spill. The bitumen particles and the 30-percent water (including dissolved PAHs and surfactants) will be driven by physical and chemical processes particular to the receiving water. On the other hand, the oil and other toxic constituents in Fuel Oil #6 may be entrained into the water column under turbulent conditions; whereas, under more calm conditions the oil would remain on the water surface as a slick with some of the hydrocarbons volatilizing into the atmosphere or dissolving into the water column. Thus, the comparative process is complex, and it goes beyond the inherent acute toxicity of the two fuels.

Second, the Orimulsion® components are not simply released as dissolved chemicals into the aquatic environment; rather, many of these chemicals have relatively low solubilities in seawater and relatively high affinities for sorbing onto particles. Consequently, through application of an equilibrium partitioning theory, it appears that most of the PAHs in Orimulsion® would either remain attached to the bitumen particles or become attached to other particles suspended in the water column, reducing their bioavailability and thus exposure to biota in the ecosystem. In fact, French (2000) suggests that this partitioning process alone would limit total PAH concentrations to a maximum dissolution of 30 parts per billion (ppb), a factor that itself would significantly limit potential toxic effects from Orimulsion® spills.

Third, Orimulsion® is essentially a pre-dispersed fuel, meaning that once released into the aquatic environment, it mostly continues to disperse, thereby resulting in diminishing concentrations over time following a spill. A key aspect of this dispersal is the relative absence of surfacing of the bitumen from Orimulsion® as a slick compared to the almost complete surfacing of the mass of spilled Fuel Oil #6 as a slick in Bay of Fundy waters. In general, oil surfacing is a concentrating process, not a dispersal process; that is, surfacing effectively concentrates a material at the interface of the seawater and the atmosphere. Since Fuel Oil #6 surfaces much more completely than the bitumen from Orimulsion®, there is a much greater concentration process for Fuel Oil #6 than for Orimulsion®. This is a critical factor for several reasons.

The surfacing of Fuel Oil #6 following a spill concentrates the mass of the spill on the water surface as a slick; the water surface is an interface of biological importance to fish, aquatic invertebrates, plants, birds and marine mammals. Most importantly, the surfacing of Fuel Oil #6 means it is primarily subject to movement by winds and near-surface currents. This is in contrast to the bitumen particles, which remain mostly in the water column (typically 90% would remain non-surfaced under Bay of Fundy conditions) and, therefore, would most likely be driven by tidal and other currents. This difference in mode of transport between the two fuels means that the spill of Fuel Oil #6 can quickly reach VECs and critical habitats in the Bay of Fundy (which are primarily located along the coastlines) much sooner and in greater quantity than Orimulsion®.

It also means that the predictability of where the spilled fuels would go is quite different. For example, the winds of the Bay are less predictable than the currents, reach greater speeds, and thus, are able to move the oil slick faster than the current-driven bitumen; and these winds may continue in the same direction for prolonged periods of time, moving the Fuel Oil #6 slick greater distances than the Orimulsion® components.

A fourth reason why Fuel Oil #6 may present a greater risk to the environment than Orimulsion® is that the biological effects of the spilled fuels are not limited to toxic responses from the chemicals in the fuels. Rather, most of the potential ecological risks from Fuel Oil #6 are associated with the physical oiling of biota following a spill. The effects of heavy fuel oil slicks on shorelines, birds, marine mammals, and coastal habitats are well documented. These are accentuated in cold water habitats such as those found in the Bay of Fundy. For example, oiling of birds and mammals can result in loss of waterproofing, which can impair the survival of these warm-blooded animals; and in cold environments such as the Bay of Fundy, even partial loss of waterproofing can result in hypothermia and death.

Since a Fuel Oil #6 spill would have a significantly higher mass surfacing to form an oil slick, that environmental behaviour and fate in itself indicates that the ecological risk from oiling is significantly greater for Fuel Oil #6. In fact, there are much larger surface areas swept by a slick of Fuel Oil #6 than the surfaced tar balls from a spill of Orimulsion® under identical conditions, meaning a larger water surface area would be available for a bird or other animals to be exposed to oiling.

Similarly, there would be much larger lengths of shorelines and areas of shoreline habitats exposed to oiling from a Fuel Oil #6 spill than from the identical spill of Orimulsion®. This difference in exposures is large, consistent, and directly related to ecological effects. If for no other reason than this, the ecological risks from Fuel Oil #6 exceed the risks from Orimulsion®. A secondary effect related to exposure to oil slicks includes inhalation of toxic volatile compounds by birds and marine mammals in contact with or in the vicinity of heavy fuel oil spills. Orimulsion® has very low concentrations of volatile aromatics and is expected to have no inhalation effects on birds or marine mammals.

In addition, the nature of the material that would surface from these two fuels is quite different; the Fuel Oil #6 surfaces as a continuous slick, such that an area with 1 gram per square meter (g-m^{-2}) or more of surfaced oil would be completely covered with sufficient mass to cause oiling effects on birds (French *et al.*, 2002). In contrast, the surfaced mass of bitumen (tar balls) from an Orimulsion® spill would be one tenth of the mass of surfaced Fuel Oil #6. Additionally, the bitumen that surfaces would be distributed as small tar balls, on the order of 1 millimeter (mm) in size. This is based not only on model simulations, but also on observations made from the limited number of controlled spills of Orimulsion® at sea, in which observers referred to the surfaced material as looking like "tea leaves." Larger tar balls have been observed in laboratory flume studies conducted at Battelle (1998), but a slick does not form.

Based on model predictions, in the case of Orimulsion®, calculations indicate that if 1 g-m^{-2} (the heavy fuel oil threshold for oiling) of bitumen was on the water surface, only 1/1,000th of the water surface area would be covered by bitumen tar balls. Tar balls may stick to birds swimming on the water surface, but this is expected to be a superficial contamination of the feathers. The only conditions under which birds have been observed to have bitumen stuck on their feathers were during an experiment conducted by Wolfe et al. (2001) using mallards. In this experiment, one group of mallard ducks was allowed to swim in water containing 100 ppm of Orimulsion® and another group of ducks was allowed to swim in water containing 100 ppm of Fuel Oil #6 (fuel mixed into the water column). These experiments showed that the swimming action of the mallards lead to feather contamination on 40 to 45% of their bodies (abdomen) when exposed to Orimulsion® and oiling of 80% of their bodies when exposed to Fuel Oil #6. However, the percentages may not adequately reflect the difference in the way the two groups of birds were oiled. The bitumen does not seem to wick into the feathers in the same way as Fuel Oil #6, so the Orimulsion®-exposed birds never became as wet to the skin as the birds exposed to Fuel Oil #6. The bitumen oiling was more of a superficial contamination of the feathers, as opposed to the typical oiling effect observed for Fuel Oil #6.

This CERA conducted for the CCGS focused on uncontained and unmitigated accidental spills. It is important to note that, should an accidental spill of either fuel occur in the Bay of Fundy, efforts would be carried out to contain and/or recover some of the spilled fuels.

Analysis conducted by Captain William Holt (2002) indicates that both the likelihood of a transportation spill occurring and the volume of fuel released would be much lower for Orimulsion® than for Fuel Oil #6. This is a result of the spill prevention measures used for shipments of Orimulsion® worldwide, compared to the present practices for shipping Fuel Oil #6 in the Bay of Fundy. An important component of this distinction is the requirement by PDVSA-Bitor of shipping Orimulsion® in double-hulled vessels, in contrast to the present situation in which 5% of the shipments of Fuel Oil #6 servicing the CCGS involve using double-hulled vessels. The significance of this preventive measure is important, as the double-hulled vessels would require a much greater force to breach both the hulls than a single-hulled vessel. As Holt (2002) documents, the risk of spills from a double-hulled vessel in a grounding situation is an order-of-magnitude lower than for single-hulled vessels, and about 29% less for a collision.

In a comparative sense, under similar collision or grounding energy conditions, the volume spilled from a breach in a double-hulled vessel is expected to be smaller than the volûme spilled from a single-hulled vessel. This is because the same force that would open a gaping hole in a single-hulled vessel would open a smaller hole in the inner hull of the double-hulled vessel. As a result, the volume of spilled fuel from a similar incident would be expected to be less from a double-hulled vessel compared to a single-hulled vessel. It is also important to note that there has never been a major spill from a collision involving a double-hulled vessel anywhere in the world; whereas, large spills from single-hulled vessels are common. The use of double-hulled vessels is a major risk-reduction step that can mean the difference between an incident resulting in a major spill or not.

Dr. Michael Moore of the Woods Hole Oceanographic Institution in Woods Hole, Massachusetts, conducted a review of comparative effects of spills of Fuel Oil #6 and Orimulsion® on the Right Whale, Harbour Porpoise, and Harbour Seal in the Bay of Fundy (Moore, 2002). His review concluded that the primary significant risk appears to be to Harbour Seals exposed to a Fuel Oil #6 spill. He also concluded that Harbour Porpoises and Right Whales would likely avoid major effects from Fuel Oil #6 spills. In his review, Dr. Moore stated that Orimulsion®, due to its lack of slick formation, lower BTEX and PAHs, and propensity to disperse, especially in the strong tidal zones of the Bay of Fundy, is likely to be less of a problem for the three marine mammal species evaluated than heavy fuel oils.

Based on the combined ecological consequences and the probability of spills based on preventive measures planned, the conclusions of this CERA are that transportation spills of Orimulsion® in the Bay of Fundy present a lower ecological risk to aquatic resources than presently exists from shipments of Fuel Oil #6.

7.3.7.2 Comparative Effects Assessment

Orimulsion® is derived from geological deposits that have become highly weathered over literally hundreds of millions of years. This means that the more volatile toxic constituents of these bitumen deposits (*e.g.*, PAHs and BTEX compounds) have long been degraded. In contrast, Fuel Oil #6 is effectively the bottom of the barrel from the petroleum processing, and with variable additives added to this residue, typically contains one or two orders-of-magnitude more of these PAH and other toxic constituents than the bitumen of Orimulsion®. This means that the fuels themselves have intrinsically different toxicities, with Orimulsion® being much less toxic than Fuel Oil #6.

7.3.8 Cumulative Effects Assessment

Based on the combined probability and consequences aspects of this comparative risk assessment, it can be stated that the transportation/offloading of Orimulsion® in the Bay of Fundy presents a significantly less ecological risk than that exists from shipments of Fuel Oil #6. Conversion of the CCGS would constitute a significant step in a risk-reduction policy for protecting the environment of the Bay of Fundy.

The low concentrations of BTEX and PAHs in Orimulsion® are expected to quickly dilute, dissolve and evaporate and these dissolved aromatics do not bioaccumulate in aquatic species (CERA, Gobas, 1989); therefore, dissolved aromatics are not expected to have a chronic effect from a short-duration spill into the Bay of Fundy. Only continuous, chronic releases of materials with these constituents could lead to long-term cumulative impacts.

The bitumen particles will disperse in the water column, and the tar balls are expected to float, disperse and eventually settle out in the Bay.

The long-term effect of Orimulsion® (bitumen particles in the water column) on aquatic species was evaluated by Golder/HydroQual (2001) by conducting an early life stage (embryo to fry) 34-day test using fathead minnows. The results of this test showed that the long-term effects of the bitumen particles in the water column were similar to the acute (short-term) effects found using juvenile fish. Studies conducted by the DFO using sea scallops showed no effect of the bitumen particles in the water column on this filter feeding species (CERA, Amsworthy *et al.*, 2000).

The long-term effect of bitumen and Fuel Oil #6 in sediments was evaluated by Environment Canada and Golder (Johnson *et al.*, 2002, BoFEP, Nova Scotia, May 12 – 14, 2002) using a standard species (*Hyallela*) in 2001 and *Corophium*, an important benthic amphipod in the Bay of Fundy, in 2002. Following a 20-day exposure, this study found that Orimulsion® had a lower effect than Fuel Oil #6 (for both species) on the long-term survival and growth of marine amphipods.

Based on the chemical properties of Orimulsion®, Environment Canada (CERA, Wang 2002a) concludes that bitumen is a very weathered product and contains a very low concentration of PAHs and BTEX. These chemical properties and the similarity of acute and chronic tests results indicate that the effect from an Orimulsion® spill is expected to be primarily an acute effect. Based on the information available, the bitumen particles in the environment are expected to be relatively inert and are not expected to have chronic effects which are lower than the acute effects documented.

Finally, as consistently seen in this CERA, any longer term effects that might occur would only be greater for Fuel Oil #6 than for Orimulsion®, for the simple reason that the former has much higher initial concentrations of toxic constituents than does Orimulsion®.

There is a reduction in risk associated with the Project and, therefore, a cumulative effect assessment is not necessary.

7.3.9 Mitigation

7.3.9.1 Operations Factors

Any supplier of Orimulsion® into the Port of Saint John will be required to follow Bitor's corporate commitments related to the shipment of fuels. Bitor has committed to a number of risk management tools that will be employed to reduce the risk of transporting Orimulsion® to a Saint John Port. The following sections describe these measures.

Vessel Selection

Vessels are to be chosen through the use of a "vetting" system based on criteria determined by Bitor to ensure careful selection of vessels, crews, and operators. The intent of this selection process is to ensure that the vessels chosen for charter meet or exceed international standards. One such criterion that will be employed is the use of the Mackenzie rating system.

Double Hulls

Only double-hulled vessels will be used for deliveries of Orimulsion®. Tank ships of the size to be used in this trade that are equipped with double hulls have been found to reduce spills from groundings by 90% and from collision by 29% (1990 Det norske Veritas (DnV) study "Comparative Study on Potential Oil Spill in Collision and/or Grounding").

Crew and Operator Selection

Bitor has indicated a commitment to high standards of training for crewmembers. This commitment can reduce the occurrence of human error as a cause of spills.

Additionally, officers selected for Orimulsion® tankers must speak both English and the mother tongue of the predominant crew nationality. The ability to communicate efficiently with the crew in an emergency is an important risk reduction tool.

Vessel Age

The screening of ships using a vetting system and the commitment that ships in the Orimulsion® trade to the Port of Saint John be equipped with double hulls will have the effect of removing some older ships from trade in the Bay of Fundy and to the Port of Saint John. There is commitment to using vessels less than 15 years old, and hence an average well below 15 years old, compared to the existing fleet average age of 16.5 years old.

7.3.9.2 Mitigation Effectiveness

While the effect of these management practices has not been quantified, they all contribute to an increase to the level of protection of the sensitive Bay of Fundy ecosystem.

7.3.10 Residual Environmental Effects

The predicted residual environmental effects of the Project on the marine ecosystem of the Bay of Fundy are positive when compared with Fuel Oil #6. Specifically, the Project results:

- Reduction in the probability of spill related to fuel for CCGS.
- Reduction in the consequences of a spill if one were to occur.
- In combination, these two factors mean a reduction in risk associated with marine fuel delivery to the CCGS.

In conclusion, the Project leads to an increase in protection to the Bay of Fundy.

7.4 Terrestrial, Wetland and Freshwater Assessment

7.4.1 Scope of the Assessment

This section is focused on examination of the effects of construction and operation of the proposed Project on terrestrial, wetland and freshwater VECs. The examination will focus on those elements of the Project as described in Section 4.0 (Project Description) that have the potential to affect the identified VECs (Table 7.29).

TABLE 7.29 Potential Environmental Effects due to Project Activities

Potential Environmental Effects	Project Phase	Activities
Freshwater - Loss of fish habitat	All	Pipeline construction, construction and operation of solid waste disposal facilities, operation of water supply facilities, accidental events
Loss of terrestrial habitat	Construction	Construction of pipeline and solid waste facilities
Loss of wetland habitat	Construction	Construction of pipeline and solid waste facilities, accidental events
Species at Risk	Construction	Construction of pipeline and solid waste facilities, accidental events

The assessment will focus on the potential for net loss of habitat function and the assessment of the significance of any such loss. The primary sources of information for the assessment are the various component studies that address these VECs namely: Environmental Background Study for the Solid Waste Storage and Disposal Area (JWEL, 2002a), Freshwater Supply Study (JWEL, 2002b) and the Fuel Delivery System Environmental Assessment (AMEC, 2002).

Any required field surveys will be implemented and the design of the studies will be developed in consultation with the appropriate expert authorities.

Environmental Assessment Boundaries

Two levels of spatial boundaries were established for this investigation, the first is a general Study Area boundary while the second level relates to the nature of a potential interaction with a specific VEC. The general Study Area boundary, from the three components studies extends from the Black River Road in Saint John to Coleson Cove, bounded to the North by the Spruce Lake and Musquash Water Supply lakes. The boundaries for fish habitat assessment included the watersheds encompassing the watercourses directly affected by Project activities, as well as operation, terrestrial habitat was assessed by consideration of similar habitats in the Study Area, all wetlands potentially affected by construction or operation of the facility were considered.

The temporal boundaries included the construction phase, scheduled to be three years, and an operational phase, scheduled to be approximately twenty-five years.

Administrative Framework

The Project as now defined is subject to a variety of Federal and Provincial Regulations, these regulations are listed in Table 7.30.

7.4.58

TABLE 7.30 Environmental Legislation and Guidelines which may be Applicable to the Coleson Cove Refurbishment Project

Issue	Applicable Legislation/Guidelines	Regulator, Agency
Environmental Impact Assessment Filing and Approval	• Environmental Impact Assessment Regulation	• NBDELG
Handling, storage and/or transportation of hazardous and/or dangerous goods (e.g., oils, fuels, gasoline, etc.)	• *Transportation of Dangerous Goods Act*, S.C. 1992, c. 34 • Transportation of Dangerous Goods Regulations, S.O.R./85-77 • General Regulation – *Transportation of Dangerous Goods Act*, N.B. Reg. 89-67 • Petroleum Product Storage and Handling Regulation - *Clean Environment Act*, N.B. Reg. 87-97	• Transport Canada • Department of Public Safety (New Brunswick) • Department of the Environment and Local Government/Department of Health and Wellness (New Brunswick)
Groundwater, surface water protection	• *Fisheries Act*, R.S.C. 1985, c. F-14 • Water Quality Regulation - *Clean Environment Act*, N.B. Reg. 82-126 • Water Well Regulation - *Clean Water Act*, N.B. Reg. 90-79 • Watercourse Alteration Regulation - *Clean Water Act*, N.B. Reg. 90-80 • Protected Area Exemption Regulation - *Clean Water Act*, N.B. Reg. 90-120 • Wellfield Protected Area Designation Order - *Clean Water Act*, N.B. Reg. 2000-47	• Fisheries and Oceans Canada • Department of the Environment and Local Government/Department of Health and Wellness (New Brunswick)
Drinking Water Quality	• *Guidelines for Canadian Drinking Water Quality* (Minister of Supply and Services Canada, 1996) Cat. No. H48-10/1996E • Potable Water Regulation - *Clean Water Act*, N.B. Reg. 93-203	• Health Canada • Department of the Environment and Local Government/Department of Health and Wellness (New Brunswick)

TABLE 7.30 Environmental Legislation and Guidelines which may be Applicable to the Coleson Cove Refurbishment Project

Issue	Applicable Legislation/Guidelines	Regulator, Agency
Works or undertakings affecting fish habitat (*e.g.*, alteration, disruption, destruction)	• *Fisheries Act*, R.S.C. 1985, c. F-14 • Watercourse Alteration Regulation - *Clean Water Act*, N.B. Reg. 90-80 • Watercourse Alterations Technical Guidelines	• Fisheries and Oceans Canada • Department of the Environment and Local Government/Department of Health and Wellness (New Brunswick)
Species Protection	• *Canada Wildlife Act*, R.S.C. 1985, c. W-9 • *Migratory Birds Convention Act*, S.C. 1994, c. 22 • Endangered Species Regulation - *Endangered Species Act*, N.B. Reg. 96-26 • Wildlife Refuges and Wildlife Management Areas Regulation - *Fish and Wildlife Act*, N.B. Reg. 94-43 • *Ecological Reserves Act*, S.N.B. 2000, c. E-1.1 • Forest Management Manual for Crown Lands	• Committee on the Status of Endangered Wildlife in Canada (COSEWIC) • Environment Canada • Department of Natural Resources and Energy (New Brunswick)
Wetlands Protection	• Federal Wetlands Policy (Government of Canada, 1991) • *Migratory Birds Convention Act*, S.C. 1994, c. 22 • Watercourse Alteration Regulation - *Clean Water Act*, N.B. Reg. 90-80	• Environment Canada • Department of the Environment and Local Government/Department of Health and Wellness (New Brunswick)

In addition to the regulations listed in this table, elements of the Project will be subject to the NB *Pipeline Act* and Regulations.

Technical Boundaries

The investigations were commenced in 2001 and were the basis of the assessment. Information for the assessment was developed from existing records and in those cases where there is potential for sensitive species to exist, a precautionary approach was taken, consistent with other such projects. Additional pre-construction field surveys will be conducted where appropriate. This approach involves the identification of mitigation in the event that species or habitats of concern are identified.

Likely Future Conditions

Should the Project not proceed, the existing fuel delivery system will continue for the anticipated remaining life of the CCGS. Additional landfill requirements will also be required. The VECs will continue to be subject to any accidental events that may occur associated with the existing project components.

Determination of Significance

CEAA has been used as a framework for the early identification, prevention and management of adverse environmental effects potentially resulting from the proposed Project. CEAA has been successfully applied to similar projects in the past, and has been widely accepted by government and regulatory agencies within Canada, as the standard for the completion of EAs. For a full description see Section 2.

7.4.2 Environmental Effects Assessment

The effects criteria used for the assessment are presented below:

- for fish habitat, a significant adverse effect is defined as a net loss of habitat function.
- for wetlands; a significant adverse effect on a defined wetland with respect to wetland wildlife habitat/species is defined as a measurable net loss of wetland function.
- for species at risk; a significant adverse effect is defined as a permanent measurable decrease in regional density of the population below naturally occurring levels. For species designated as endangered, (or significant for other reasons) the loss of these species at an individual level may be considered a significant adverse effect.
- Terrestrial habitat, including that for migratory birds; a significant adverse effect is any reduction in the amount of critical habitat available for species below that required to support current populations. In this sense, nests or nesting areas that are currently in use are defined as critical habitat, disturbance of which would be a significant adverse effect.

7.4.2.1 Fish Habitat

There is potential for the proposed Project to have effects on the following watercourses, for the pipeline construction – Bean Brook, Beyea Brook and Little River; for the solid waste storage and disposal area – Shannons Lake Brook and tributary and for the water supply, the Spruce Lake and Musquash Lake systems.

Increased water usage is expected to only affect the Loch Alva reservoir. The normal operational levels in the reservoir range from slightly over 17 ft of live storage in the spring to a low of 12 ft of live storage in the fall. The increased water usage could result in a maximum 0.24 ft (7 cm) reduction in live storage in the fall (*i.e.*, a new operational low of 11.76 ft of live storage).

The effect on water quality (water temperature, algal growth and turbidity) is expected to be negligible. The increased drawdown in the reservoir resulting from the increased water usage is expected to have a negligible effect on shoreline ecology as the additional drawdown will not influence spring-spawning fish species (such as bass).

Construction

The Component Study report considered Horizontal Directional Drilling (HDD) as a method to cross all watercourses during pipeline construction. In this technique the drilling equipment is set-up a minimum of 30 m from the watercourse and the drill bit is retrieved at a minimum of 30 m from the other side. This effectively eliminates any contact with the watercourse. In the event that HDD cannot be used, an environmentally acceptable alternative method will be used. This alternative method will be communicated to the appropriate authorities and the appropriate permits obtained. In any case fish and fish habitat will be protected.

Acid drainage may be generated from areas where acid-producing rock is exposed and from areas where waste acid producing rock is disposed and may enter a receiving stream in the form of surface run-off. It is not known at the present time if acid-producing bedrock will be encountered in the proposed pipeline Project Area.

There is potential to encounter contaminated soils within the urban portions of the proposed construction areas. Contaminated areas will be remediated to meet all applicable regulatory requirements.

IOL has advised that they are initiating their studies into the potential pipeline route, and IOL has assured NB Power that a mitigation strategy will be developed and implemented should acid rock or contaminated soils be identified through these studies.

Construction of the pipeline will also require hydrostatic testing to ensure pipeline integrity. There is potential for negative effects on fish populations if water for these tests is obtained from small streams or disposed in inappropriate locations. In this case, there is opportunity for the water to be obtained from existing municipal water supplies and returned to either a municipal or industrial water treatment system, which should eliminate potential for adverse effects on fish or fish habitat.

Shannons Lake Brook and tributary have habitat suitable for the support of fish populations and fish were observed in these streams. The primary source of potential concern during construction of the proposed SWSDA has to do with the potential uncontrolled release of sediments into the watercourses during construction. Such uncontrolled releases during construction of the facility may damage fish habitat and extreme releases may result in mortalities. The most effective way to minimize this potential includes design and implementation of appropriate construction practices and education of the construction work force. Both these elements are outlined in the sections below.

Operation

No potential adverse effects have been identified during the operational phase of the pipeline. There will be a continuing increase in the volume of material stored in the proposed SWSDA during the life of the Project. There are two potential sources of concern during operation, surface runoff and groundwater contamination.

The proposed SWSDA will occupy approximately 2.8% (one cell) or 11% (all cells) of the total watershed area of Shannons Lake Brook. The potential surface runoff will be controlled through a progressive re-vegetation program to minimize potential contaminant release. It is anticipated that the rate of runoff to the watercourses could be increased, due to the increased slopes of the SWSDA and soil cover with lower permeability. Based on the area affected as a proportion of the total area of the watershed, such increases are not anticipated to be significant.

The primary source of potential contamination of the receiving waters from the facility is through contamination of groundwater. For this analysis, leachate chemistry for the proposed new SWSDA was obtained from NB Power records from Dalhousie. The Component Study concluded that for the chemicals identified, the potential concentrations in the Brook will be well below "Guidelines for the Protection of Aquatic Life" as issued by the Canadian Council of Ministers of the Environment (1999).

Water Supply

The freshwater supply for the proposed Project will use the existing pipeline and water supply system that is linked to the City of Saint John water supply system. The City of Saint John operates the Spruce Lake system that is augmented by water from the Musquash system as required. The procedure is to pump from the Musquash system when the City requires it. The proposed increase in water required, as indicated in JWEL 2002b, will require relatively little additional pumping from the Musquash system. With respect to fish habitat, the existing maximum drawdown from the primary source of water in the Musquash system is approximately 1.5 m. The increased volume of water required for the Project would result in an additional 0.07m of drawdown. This potential increase would be similar to wave action or seiche activity due to wind and would not have a measurable effect on fish habitat.

The additional water withdrawal will not affect the operation of the Log Falls Reservoir, the Seven Mile Reservoir, or the West Branch Musquash Reservoir.

It is worth noting that the 7 lakes that make up the water supply adequately supply water to the City, allow generation of electricity at the Musquash facility and require regular spilling of excess water from the Loch Alva Reservoir, the East Branch Reservoir and the West Branch Musquash Reservoir. The water level in these reservoirs is managed by NBDNRE.

Based on the current capacity of the pumps which connect the Spruce Lake system to the Musquash system, the additional water withdrawal will require an additional 4 days of pumping from the East Branch Musquash Reservoir (refer to Figure 4 in Surface Water Supply Study for schematic of Musquash system). In order to meet this demand, additional water will be released from the Loch Alva Reservoir to the East Branch Musquash Reservoir.

The typical operational regime of the Loch Alva Reservoir ranges from an elevation high of slightly more than 117 ft in the spring (equivalent to 17 ft of live storage) to an elevation low of 112 ft in the fall (equivalent to 12 ft of live storage). Based on the storage curve for the Loch Alva Reservoir, the additional water withdrawal could result in a 0.24 ft (7 cm) lowering of the water level in the reservoir. As a result, the operational low would become 111.76 ft (equivalent to 11.76 ft of live storage).

Accidental Events

Accidental events have potential to have significant adverse effects on fish habitats. Such events could include uncontrolled releases of materials from pipelines or from the SWSDA.

If a leak from the existing pipeline were to occur in the vicinity of the Saint John River, the extremely high currents and turbulence of the Reversing Falls area of the Saint John River would rapidly entrain and disperse both Fuel Oil #6 and Orimulsion®. Both fuels are likely to oil the shorelines and have similar effects under these circumstances.

In freshwater the bitumen particles would disperse, and not coalesce or float to the surface. Thus, the Fuel Oil #6 spill would oil the banks downstream of the spill, while the Orimulsion® would not form a surface slick and would be carried downstream and dispersed into the Bay of Fundy at the stream mouth. When the bitumen particles reach brackish waters (> 5ppt salinity) at the stream mouth, bitumen particle coalesce can occur and these particles are expected to float to the surface as tar balls or settle in areas of natural deposition.

Orimulsion® released via a spill onto the land would initially behave similarly to Fuel Oil #6. The mobility of the Orimulsion® through the soil will be much different after the emulsion breaks. After the emulsion breaks, the heavy bitumen would tend to fill the available pore space, therefore limiting the depth of penetration. The total travel distance of a terrestrial plume of Orimulsion® would therefore be expected to be much less than a plume of a similar quantity of Fuel Oil #6.

Mitigation

Monitoring to ensure the integrity of the pipeline systems and the environmental protection measures in the SWSDA will assist in prevention of such events and contingency plans to be developed for both aspects will assist in mitigating any unforeseen events.

Several mitigation measures have been identified in the text above including source and disposal of hydrostatic test water, sediment and erosion control measures and monitoring for environmental effects. The primary mitigative measure for the construction of the proposed landfill includes application of the generic New Brunswick Solid Waste Landfill Design criteria (JWEL, 2002a).

In addition, NB Power will work with the owner of the pipeline to investigate specific mitigation measures in the event of a leak in the vicinity of the Saint John River.

Residual Environmental Effects To Fish Habitat

Given the application of the mitigation described above and with the appropriate monitoring as is outlined in the identified component studies, significant adverse impacts to fish and fish habitat are not likely.

Cumulative Effects on Fish Habitat

Cumulative effects were considered for within Project activities as well as for known projects in the planning stages. The major potential project which may effect the VECs identified in this section is any pipeline associated with the proposed Irving Oil LNG Plant. Should such a line be constructed, it is anticipated that it would follow the proposed line from Canaport to the existing pipeline. In that event, this line would follow an existing corridor, which is accepted practice from an environmental planning viewpoint. The LNG Plant has been registered under the New Brunswick EA Regulation and as such will be required to undergo an environmental impact assessment review similar to that of the current Project. In that event it can be anticipated that fish and fish habitat will be considered and any identified effects will be mitigated to an acceptable level. Given this and the fact that the current project has identified no measurable effects to fish habitat, no further cumulative effects analysis is required.

7.4.2.2 Wetlands

Construction

The proposed pipeline conceptual route is located within 30 m of four wetlands that are identified in the New Brunswick Wetland atlas and/or Forest Inventory Maps. Construction of the proposed pipeline has the potential to interact with wetland habitats through hydrostatic testing and regular maintenance and repair activities. The effects include soil erosion and water quality effects. As indicated in the Fuel Delivery System – Environmental Assessment (AMEC, 2002), it is considered that any wetlands encountered will be crossed using a HDD method and hydrostatic testing will use municipal water supplies and treatment facilities, therefore, no potential effects are anticipated. If alternatives are proposed, appropriate information will be collected and permits obtained prior to construction. To reduce impacts on wetlands, there should be no cutting of vegetation in wetlands or their buffers. As HDD will be used, vehicles should not be allowed to cross wetlands or buffers in association with the construction activity and RoW preparation. In addition, all project activity should be at least 30 m from the wetland boundary of Red Head Marsh. A site visit of this marsh should be undertaken in the upcoming months to ensure acceptable delineation of this marsh.

NB Power has confirmed that IOL will abide by all relevant legislation in the conduct of work in wetlands or their buffers. It is anticipated that HDD will be the method for the placement of the pipeline under wetlands and their buffers, and any change in this will be agreed with NBDNRE prior to construction.

The proposed SWSDA is near four wetlands, three of which are identified on the New Brunswick Wetland Atlas and the fourth of which appears to have been created by drainage interference during construction of the existing water supply pipeline. This latter wetland has an area of approximately 1 ha and, based on mapping information, approximately 0.01 ha of the wetland is located within the SWSDA site boundary. Of the remaining three wetlands, two are remote from the SWSDA and will not be directly affected.

The remaining wetland, Shannons Lake Wetland, is a deep marsh and compact shrub swamp formed by beaver activity and is approximately 2.9 ha in size. The proposed leachate/sedimentation pond for the SWSDA will directly affect only 0.06 ha of the southern tip of this wetland.

Based on the wetland descriptions provided in JWEL 2002a these potentially affected wetlands do not offer significant wetland habitat. Beaver ponds are transitional in nature and the proposed SWSDA potentially affects a small portion of either wetland.

Operations

The proposed Orimulsion® pipeline will be operated and maintained by the owner in accordance with approved industry standards and the operating permit from NBDNRE. No potential effects have been identified during the operational phase of the Project.

Saints Rest Marsh, through which the existing pipeline from the Irving Oil Refinery to Coleson Cove travels, has been identified as an important wetland (see Section 5) based on the number and variety of wetland habitat functions it provides. This Marsh continues to provide these functions in spite of the many activities that have taken place in and adjacent to the Marsh. These activities include construction and operation of a waste water treatment facility that ultimately discharges into the Marsh, construction and operation of several highways, expansion of urban housing within the watershed of the Marsh and construction and operation of a recent natural gas pipeline and of the existing pipeline from the Irving Oil Refinery to Coleson Cove. Any accidental events, such as an unplanned release of petroleum product could have serious consequences to the Marsh functions. The primary approach to avoidance of such consequences is to prevent accidental releases.

The current owner of the pipeline has initiated an extensive program to monitor the integrity of the pipeline. Where required, the line will be repaired. The likely repair process involves excavation using backhoe, cleaning the surface of the pipe and placing a jacket over the entire pipeline in the area that repairs are required. This approach is rapid and eliminates the necessity of opening the existing pipeline. The speed of the repair limits the amount of time that would be spent working in sensitive habitats while placing the sleeve over the pipe limits the potential for an uncontrolled release of material from within the line. Any such repair work to be conducted within 30 m of a watercourse, including Saints Rest Marsh, will require a watercourse alteration permit and application for this permit will require a site-specific environmental protection plan. Based on the recent (Oct. – Nov. 2001) pipeline testing and evaluation, over the next five year period, the required maintenance program for the pipeline does not require any repair actions, and is limited to an increase in cathodic protection measures, an action which does not involve any physical intrusion.

Accidental Events

Accidental events have potential to affect wetland habitats in close proximity to both the pipeline and the SWSDA. The integrity of the pipeline will be regularly monitored as will the integrity of the SWSDA. These monitoring programs and mitigation measures identified below will assist in preventing accidental events.

Residual Effects Assessment

Given the application of the mitigation described above and with the appropriate monitoring, as is outlined in the identified component studies, significant adverse impacts to wetlands are not likely.

Cumulative Effects

Because potential measurable environmental effects associated with the proposed Project are not identified for wetlands, no cumulative effects assessment will be conducted.

7.4.2.3 Terrestrial Habitat

Both the proposed new pipeline and the SWSDA involve construction activity that will require clearing land of standing timber. The total area to be cleared for the pipeline is 6 ha. and the two storage tanks will be adjacent to the existing Canaport facilities in an area of fallow field. The footprint of the total storage area, including secondary containment berms, will be approximately eight hectares. The SWSDA will require 32 ha and temporary work areas for parking, trailers, and laydown/storage (including gypsum/limestone loading area) will require approximately five hectares. Temporary work areas will displace two hectares of forested land consisting of immature mixed forest (composition is mainly birch and fir-spruce), two hectares of alder covered field (previous laydown area for original Coleson Cove construction), and one hectare of fallow pasture. The primary concern is to determine if the area to be cleared consists of habitats that are uncommon or rare in the Study Area.

The areas for Project activities were reviewed using available air photography and Forest Inventory maps. The forest types identified by this exercise were common to the majority of the Study Area. No particular areas of sensitive forest habitat, for example Old Spruce Fir Habitat, were identified as being potentially affected. In view of these common vegetation types, the focus of the terrestrial habitat review was on the potential for effects on migratory birds.

The first consideration was identification of potential effects on general migratory bird communities. The *Migratory Bird Convention Act* states that no person may disturb, destroy, or take/have in their possession a migratory bird (alive or dead), or its nest or eggs, except under authority or permit. In New Brunswick, migratory birds could potentially nest from May 1st to August 1st and begin migrations in September. Clearing associated with Project activities poses a potential threat to active nest sites if such activities occur when nests are active.

Operations

No potentially significant adverse effects have been identified during the operational phase of the Project.

Mitigation

The mitigation suggested to avoid this potential adverse interaction with migratory birds is to clear the sites outside the nesting season, ideally in late fall or winter. If construction cannot be confined to this window, a bird survey of the area will be conducted by a professional biologist/ ornithologist/birder prior to clearing activities. The bird species recorded during the survey will be used as an indicator regarding the potential nesting habitat in the area. The typical nesting habitat for these species would be investigated for nests. Any nests identified shall be left undisturbed until the chicks have fledged and abandoned the nests. The presence and type of bird nests shall be recorded.

IOL has advised that they are initiating their studies into the potential pipeline route, and IOL has assured NB Power that efforts will be made to schedule clearing activities outside of the critical nesting period.

Residual Effects Assessment

Given the application of the mitigation described above and with the appropriate monitoring, as is outlined in the identified component studies, significant adverse impacts to terrestrial habitats/migratory birds are not likely.

Cumulative Effects

Both projects will take place in areas that are currently in various stages of development. The SWSDA is bordered closely on three sides by existing roads and pipeline rights-of-way. The majority of the proposed pipeline corridor parallels existing linear corridors. The proposed pipeline when combined with other linear corridors between Canaport and the intersection with the existing pipeline will affect only 3.81% of the forested land in that portion of the Study Area. Therefore the magnitude of any cumulative effect is limited and no significant cumulative effects are anticipated from the Project activities. The combined areas of forest clearing required for the SWSDA and temporary work areas will be approximately eight hectares which represents less than half a percent of available forest habitat in the area from Coleson Cove to the Spruce Lake water supply area. Therefore, no significant cumulative effects will occur.

7.4.2.4 Species at Risk

The first task in considering the potential for interference with species at risk was to determine, based on a review of available literature, any records of species at risk occurring within the proposed Project footprint. Sources of information included the COSEWIC, the New Brunswick *Endangered Species Act*, Hinds, 2000, the AC CDC database, published and unpublished species listings, and consultations with government agencies and researchers. This assessment was followed by habitat delineation to aid in prediction of the species within the Study Area. Sources of information included the NBDNRE forest inventory maps, the New Brunswick Wetland Atlas (Canadian Wildlife Service, 1987) and air photography.

The process identified several species that potentially could occur in the Study Area, based on habitat requirements. Habitats of particular concern include watercourses and wetlands that have been discussed in the sections above. Since little if any of such habitats are affected by the proposed Projects, the likelihood of interaction with species utilizing such habitats is limited. No species at risk or critical limiting habitats have been observed in the locations of the two Orimulsion® storage tanks at Canaport or in the temporary work areas at Coleson Cove.

Construction

Clearing activities are currently planned to take place during the fall and winter that will limit effects on migratory bird species.

No federally or provincially endangered or threatened species, or other mammal, reptile or amphibian species of concern are expected to be encountered within the Study Area (JWEL, 2002a). Based solely on habitat delineation and habitat preference, three bird species of concern were identified with some potential for breeding within the Study Area for the SWSDA, although the potential is relatively low. These species have not been recorded in the area. With respect to the proposed pipeline corridor, several bird species at risk have been identified within the Study Area, which may inhabit portions of the preferred RoW. The preferred RoW does not contain habitat that is limiting or critical for any of the bird species at risk. Therefore, no significant effects are anticipated from construction activities (AMEC, 2002).

A number of rare plants have been identified as having some potential for being found in the boundary of the Project and two have been recorded within 5 km of the SWSDA. The potential for most of these species to occur within the Study Area is low (JWEL, 2002a).

Wood turtles, that are designated by COSEWIC (2001) as a species of special concern may be encountered during construction activity for both the SWSDA and the pipeline (JWEL, 2002a and AMEC, 2002). The main areas of concern for wood turtles are riparian zones, where construction activities will be limited. Therefore the primary concern has to do with encountering individuals during construction.

Operations

No potential effects have been identified during the operational phase of the Project.

Mitigation

Following is a list of mitigation that has been identified:

- avoid construction activity within riparian zones.
- Site Specific Environmental Protection Plans (SSEPPs) will be developed where required and finalized following the completion of the detailed engineering design. A SSEPP outlines approval conditions and commitments required to minimize potential

adverse environmental effects in a specific area. It also includes detailed mapping and provides clear instructions to the Environmental Inspector and construction personnel regarding procedures, programs and protocols.

- schedule clearing activity to avoid sensitive nesting periods.
- if wood turtles are encountered during clearing or construction, they are to be moved from the work area and placed within the forest adjacent to a watercourse.
- hydrostatic test water is to be withdrawn from municipal water supplies and returned to municipal or industrial wastewater treatment facility.
- application of generic New Brunswick Solid Waste Landfill Design criteria.
- provision of education on environmental protection for workforce.
- design and implementation of a monitoring program to ensure sediment and erosion control measures are functioning properly (associated with SSEPPs).
- continued monitoring and maintenance of the existing pipeline.
- Field surveys will be conducted to confirm the findings of the desktop studies, including species at risk. Following the completion of the field surveys, a report summarizing the results of the survey, including any mitigation and follow-up strategies which may be required will be prepared. The field report will be submitted to the appropriate agencies.

Residual Environmental Effects

Given the application of the mitigative measures identified above significant adverse effects to fish and fish habitat and terrestrial and wetland ecosystems, and species at risk are not likely.

7.5 Impacts on the Socioeconomic Environment

7.5.1 Socioeconomic Benefits

The direct and spin-off socioeconomic benefits of the Project during construction and over the 25 years of CCGS operation, thereafter, are the subject of a detailed Component Study (ADI 2002). A synopsis of important results is provided below.

Scope of the Assessment

Socioeconomic benefits include those benefits to the Provincial economy and society which occur as a consequence of employment creation, expenditures and labour income generation, etc. Other potential socio-economic benefits of the Project, such as reduced unemployment and welfare burden, improved economic competitiveness and development opportunity, have also been considered. The Input-Output Model multipliers used to estimate the job creation and income benefits of the Project, are consistent with those applied to the Belledune Generating Station project.

Socioeconomic benefits analyses commonly accompany major project plans and environmental assessments to alert the local community and all provincial residents of the ancillary benefits of the project. Socioeconomic benefits are referred to as externalities of a project, in that they provide benefits to recipients not directly involved in the project, and/or are benefits outside of the intended purpose of the project. The Project will generate significant employment. The economic stimulus and employment generated by the Project will benefit local area residents, provincial unions, the construction industry, the business community, and the Government of New Brunswick.

Socioeconomic benefits are comprised of the economic activity generated by the Project in the form of job creation, labour income and expenditure activity initiated by the purchase of equipment, materials and services required during construction. But the benefits extend beyond the jobs, materials and services employed directly in the Project. They continue through the spending by workers of their earned income on food, shelter, entertainment, etc., which in turn creates employment and incomes in various consumer goods and services industries, and so on.

Boundaries

The socioeconomic benefits resulting from direct employment and direct labour income have been evaluated for the three-year construction period. Construction activities will also generate spin-off employment, and purchases of equipment, materials and services within New Brunswick.

In addition, socio-economic benefits resulting from additional direct and spin-off employment have been assessed for the extended life of the CCGS. New permanent positions to operate and maintain the CCGS once the Project is complete will be created.

Effects Assessment

Table 7.31 presents the socioeconomic benefits estimated for each of the construction and operations phases broken down by direct spin-off and total benefits of the Project. A multiplier of 1.6 has been applied to the direct employment, meaning that for every job created another 1.6 jobs will be created elsewhere in the provincial economy. A labour/employment income multiplier of 0.4 has been applied, which implies that for every dollar of net income received by workers and employees of the CCGS another $0.40 of economic activity is generated elsewhere in New Brunswick. Similarly, a multiplier of 0.2 has been applied to the direct expenditures on equipment materials and services during construction supplied from within the Province, which will spin-off another $0.20 for every dollar spent.

TABLE 7.31 Socioeconomic Benefits

Construction Phase*	Direct Benefits	Spin-off Benefits	Total Benefits
Employment (in Person-Years)	2,150	3,440	5,590
Labour Income (in $ Million)	$230	$92	$322
Other Equipment, Materials and Services Expenditures (in $ million)	$220	$44	$264
Operations Phase**			
Net Employment (in Person-Years)	1,387	270	1,657
Net Employee Income (in $ Million)	$93	$27	$120

Notes:

* Three year construction period

** Operations will generate a net of 4 jobs per annum for the first 12 years, and will include all 103 full-time jobs (99 existing and 4 net) during remaining 13 years of extended CCGS life.

Construction Period

The direct employment generated during the construction phase has been estimated to be a total of 2,150 person-years over the three-year period. This will spin-off another 3,440 indirect and induced person years of employment. The total direct labour income paid to all of those working on the Project has been estimated at $230 million. This will spin-off another $92 million of labour income within the Province.

From the standpoint of labour availability, the Project is timely. Provincial labour demands have eased with the completion this year of the Fredericton to Moncton highway and the natural gas pipeline works. The recent completion of the oil refinery project has meant extensive local trade union layoffs, which according to Statistics Canada, contributed to an unemployment rate for Saint John of 8.7% in August, 2001, up from 7.7% in August, 2000.

Province-wide, unemployed construction workers averaged 5000 in the year 2000, which has since increased to an average of 8000 through August, 2001, with a high of 9700 in March, 2001. Based on the experience of Dalhousie, it is estimated that the Project will reach a peak of about 750 workers employed on-site. With the present availability of the Provincial and Saint John area workforce to the Project, there should be no concerns regarding upward pressures on wage rates or construction schedule delays due to construction labour shortages.
The Saint John region recently demonstrated its ability to accommodate the skilled labour demands of the Oil Refinery construction project. Given the current labour availability since completion of the Oil Refinery upgrade, the region should be capable of accommodating the labour needs of the Project.

The Project will also generate economic activity through the non-labour expenditures on equipment, materials and services during construction. It is estimated that when the materials, equipment and services produced outside the Province are excluded, there would be approximately $220 million of direct expenditures on equipment, materials and service from within the Province. These direct expenditures will generate another $44 million of spin-offs throughout the Provincial economy, largely in the Saint John area.

In summary, the direct and spin-off benefits from the construction phase of the Project will amount to a total of 5,590 person-years of employment, $322 million of labour income, and $264 million of other expenditures on equipment, materials and services.

Operation Period

Present operations of the CCGS require 99 employees. This is expected to increase to 103 employees upon completion of the Project. In addition, the Project will allow the CCGS to operate for an additional 13 years. All employees of the CCGS will, therefore, have their jobs extended for the additional 13 years. The net employment created by the Project includes the addition of 4 employees during the first 12 years, as well as the entire 103 staff complement over the remaining 13 years of operation. In total, CCGS operations will create 1,387 person-years of net direct employment over its 25-year life. Applying the operations employment multiplier, this will spin-off another 270 person-years of indirect employment over the 25-year span.

Net direct operations employment over the life of the CCGS will be an estimated $93 million, which will spin-off another $37 million of indirect income within the Province.

In summary, the direct and spin-off operations benefits will amount to a total of 1,657 person-years of operations employment and $120 million of labour income over its 25 years of operation.

7.5.2 NB Power Health and Safety Program, and Performance Statistics

Worker safety during construction and operation will be assured by compliance with the requirements of various governing standards including the New Brunswick *Employment Standards Act* and the New Brunswick *Occupational Health and Safety Act* and regulations.

Health and Safety is administered centrally in NB Power through a Corporate group, consisting, in part, of a Director, a Manager, an Industrial Hygienist and 6 Canadian Registered Safety Professionals. Four of these individuals are accredited under the Det Norske Veritas Loss Control system.

All activities flow from an overall governing principle, internally referred to as the Health and Safety Responsibility System, that details the various Health & Safety responsibilities of all workplace stakeholders – Employer, Employee, Contractor, Local Joint Health and Safety Committees (JHSC's), and the Corporate Health and Safety Group itself.

In its relationship with field locations, the Corporate Group carries out regular on-site inspections, liaises directly with the local JHSC in the resolution of identified issues, and directs the implementation of new initiatives where opportunities for improvement arise.

Through the Joint Health & Safety Committees, a Safety Culture Program, a Safety Recognition Program and a "Safety Takes You Home" awareness campaign, NB Power employees integrate safety with all their tasks. NB Power has been awarded the Canadian Electricity Association's (CEA) "President's Award of Excellence for Employee Safety" for 2000. In 1999, NB Power received the New Brunswick Workplace Health and Safety Compensation Commission's annual Safety Recognition Award.

For all major projects carried out at its Generating facilities, specific Health and Safety requirements are identified in advance for individual contractors, whose performance and adherence to these requirements are monitored by one or more of the Safety Professionals specializing in the needs of the Generation Business Unit. These contractors are further required to adhere to all internal NB Power safety standards in addition to applicable Provincial and Federal legislation.

A Coleson Cove Refurbishment Project Health and Safety Program will be developed prior to the start of site work. This program will address structured program elements outlining responsibilities of employer, contractors and employees on site and will include specific expectations with respect to safety leadership, joint health and safety committees, loss control meetings, safety training requirements, planned inspections and audits, incident reporting and investigations, incident analysis, personal protective equipment, industrial hygiene, communications and other elements found in a comprehensive safety management system.

Corporate Health and Safety will maintain an audit function to ensure compliance with the program throughout the duration of the project. Throughout the Project, close liaison will be maintained with site safety personnel and WHSCC.

The present Coleson Cove Emergency Response Plan (CC-ERP-001) will be updated and modified to respond to any emergency situation, involving the refurbished CCGS.

Reporting of all Health and Safety issues is done formally, directly to Business Unit Management, Corporate Executives, and the Board of Directors.

There is essentially little difference between the operation of the CCGS before and after the refurbishment project, with the exception of ash, limestone and gypsum handling. With regard to the latter, policies and procedures will be developed, drawing on the experience at Dalhousie and Belledune. All contractors employed by NB Power during construction and operation must demonstrate the highest commitment to worker safety. NB Power will ensure that all contractors working on its behalf are aware of the corporate environmental policy, construction and mitigative techniques so as to minimize environmental damage, and additional mitigative measures outlined in site-specific environmental protection plans.

All employees and contractors on site must have received WHMIS training and other specific safety training as may be pertinent to their work tasks and environment. NB Power is committed to promoting employee and contractor awareness of environmental issues, and will identify training needs and will require that all personnel whose work may create a significant impact upon the environment receive the appropriate training based upon job requirements.

NB Power maintains detailed loss-time statistics and has an excellent health and safety record. The CCGS has operated in excess of 700 continuous days (over 400,000 person hours) without a lost time accident, the last one having occurred on April 4, 2000.

7.5.3 Economic Consequences of a Marine Traffic Incidence

As discussed in Golder, 2002, the potential consequences of any incident related to marine transportation of fuel through the Bay of Fundy are highly dependent on a number of variables. The physical variables include the location and size of the incident. The environmental variables include the season, the weather, the tidal state, and the local currents. These factors would also control the duration of effect that would be variable and may last for one or more seasons. The actual consequences also depend on the effectiveness of response activities and marketing and regulatory reactions, such as the duration of closures. None of these variables are predictable.

Given the large number of variables that are involved, it is assumed that the consequences, including the economic consequences could be large. Recognizing the economic value of both traditional and aquaculture activities in the Bay of Fundy (estimated value of approximately $450 million annually), the emphasis is placed on reducing risks of incidents as detailed in Section 4.

The CERA report has demonstrated that the risk, including both consequence and probability, of a spill of Orimulsion® is much lower than that of Fuel Oil #6. In fact, with over 350 million barrels shipped, there has not been an accidental release of Orimulsion® into the marine environment.

7.5.4 Archaeological/Heritage Resources

7.5.4.1 Scope of the Assessment

The scope of the assessment is to examine the effects of the various components of the Refurbishment project on federally, provincially and municipally designated archaeological and heritage resources. The assessment also considers prediction of archaeological resources through the identification of areas with elevated potential to contain such resources.

If the landscape around a resource contributes to the value of the resource, then that landscape may be considered in heritage resource assessments. This is referred to as a cultural landscape. While all archaeological/heritage sites may be said to have an associated cultural landscape, the Canadian Environmental Assessment Agency only refers to effects on *special historical or cultural landscapes*. This is a consideration given to the cultural landscapes associated with recognized sites of the calibre of Stanley Park in British Columbia, or the urban cultural landscape of Lunenburg, Nova Scotia.

This section identifies federally, provincially and municipally designated archaeological and heritage resources in the Project Area, and assesses potential impacts on those resources. Phases of the Project that may affect these resources are listed in Table 7.32.

TABLE 7.32 Potential Archaeological Effects

Potential Environmental Effects	Project Phase	Activities
Archaeological/heritage resources	All	Physical disturbance
Areas of elevated archaeological potential	All	Physical disturbance
Cultural landscape	All	Physical disturbance

The indicators of impacts to the resources are based on a consideration of the remaining number of similar resources in federal, provincial or municipal stocks. The assessment will address construction of new facilities and operation maintenance and decommissioning of the Project.

Boundaries

The environmental assessment boundary for the archaeological/heritage environment is the pipeline Right of Way, the Generating Station and proposed landfill site and the proposed tank farm at Canaport, two booster stations, temporary work areas and gypsum storage at the Generating Site, (i.e., the Project Footprint) and immediately adjacent cultural landscapes.

The assessment of archaeological/heritage resources will include the construction period of three years, and the Operation period of 25 years.

Administrative Boundaries

The Parks Canada Agency of Canadian Heritage protects and presents nationally significant examples of Canada's cultural heritage through national programs such as National Historic Sites of Canada (*Historic Sites and Monuments Act*), and Federal Heritage Buildings (*Canadian Inventory of Historic Building*). The Archaeological Services Unit, and the Heritage Branch of Culture & Sport Secretariat are provincial regulators of designated archaeological sites, heritage structures and Historic Sites (*NB Historic Sites Protection Act*). The City of Saint John administers municipally designated heritage resources through the Planning Department and the Heritage Preservation Review Board (*NB Municipal Heritage Preservation Act,* and the *Saint John Preservation Areas By-Law).*

7.5.4.2 Technical Boundaries

Designated heritage resources generally represent resources that are recognized nationally, provincially or municipally on behalf of the public for their educational, cultural, or economic values. Designated heritage resources do not consider unknown resources or resources that are not considered significant on some level. Databases reflect information collected as a result of activities, research or fieldwork undertaken in an area. Areas where no data has been collected may have significant heritage resources not yet documented in a database. The model used to predict areas of elevated potential was a tabletop exercise and is subject to certain technical limitations such as scale and a range of cultural factors. Criteria used to identify areas of elevated potential are based on characteristics commonly associated with heritage sites in the Maritimes region, including the presence of previously recorded heritage sites, areas of historical settlement. The model does not consider disturbance to heritage resources caused by development, nor does it consider the significance of surviving resources.

Baseline

Designated heritage resources were identified based on databases described in Section 5. Resources and data collected during the Maritimes and Northeast Pipeline Saint John Lateral Pipeline Project were considered in the review of heritage resources for the Project Area (WGA, 1998), as was an environmental study of the solid waste storage and disposal area for the Project (JWEL, 2002). That study indicates there is very little potential for any archaeological resources to be located in that area, and it is unlikely any activities associated with that project will have any impact on heritage resources. That assessment recommended that no further work was required.

Likely Future Condition

No federally, provincially or municipally designated archaeological/heritage resources were identified within the Project Footprint. Therefore there is not expected to be change to the condition of those resources if the Project is not approved. The only sources of change to the condition of archaeological resources in areas of elevated potential if the Project is not approved is from actions such as coastal erosion, urban or industrial development.

Effects Assessment

Municipal, provincial, and federally designated heritage resources were the focus of the assessment. Databases were reviewed to determine if designated heritage resources occurred within the Project Footprint, as defined above, or in immediately adjacent cultural landscapes.

The following categories of archaeological/heritage resources were considered (refer to Section 5.9):

- Provincially Designated Archaeological Sites
- Municipally Designated Heritage Preservation Areas
- Provincially Designated Historic Sites
- Nationally Designated Historic Sites
- Heritage Structures
- Areas of Elevated Archaeological Potential

Provincially Designated Archaeological Sites

Databases were reviewed to determine if provincially designated archaeological sites occurred within the Project Footprint or in immediately adjacent cultural landscapes. As a result of the database review, no resources of this nature were found to occur within any of these areas, and therefore there should not be Project related environmental effects on these resources.

Municipally Designated Heritage Preservation Areas

Databases were reviewed to determine if municipally designated Heritage Preservation Areas occurred within the Project Footprint or in immediately adjacent cultural landscapes. As a result of the database review, no resources of this nature were found to occur within any of these areas, and therefore there should not be Project related environmental effects on these resources.

Provincially Designated Historic Sites

Databases were reviewed to determine if provincially designated historic sites occurred within the Project Footprint or in immediately adjacent cultural landscapes. As a result of the database review, no resources of this nature were found to occur within any of these areas and therefore there should not be Project related environmental effects on these resources.

Nationally Designated Historic Sites

Databases were reviewed to determine if nationally designated Historic Sites occurred within the Project Footprint or in immediately adjacent cultural landscapes. As a result of the database review, no resources of this nature were found to occur within any of these areas, and therefore there should not be Project related environmental effects on these resources.

Heritage Structures

Over an estimated 6000 heritage structures occur with the Study Area. Based on the Project Design, no impacts are predicted on any of the heritage structures in the Project Footprint and therefore there should not be Project related environmental effects on these resources.

Areas of Elevated Archaeological Potential

Mapping and databases were reviewed to determine if areas of elevated archaeological potential occurred within the Project footprint or in immediately adjacent cultural landscapes. Several areas of elevated archaeological potential were found to occur within some areas of the Project Footprint and are described in Section 5.0. In areas where the Project Footprint crosses areas of elevated archaeological potential during construction, operation, maintenance and decommissioning related activities (clearing, grubbing, grading, soil removal, soil deposition, excavation, spill cleanup) there is a potential to effect archaeological/heritage resources.

7.5.4.3 Cumulative Environmental Effects

Areas of Elevated Archaeological Potential

There are areas of elevated archaeological potential found to occur within the Project Footprint. The potential for cumulative effects will be reduced with the implementation of appropriate mitigation (see below).

7.5.4.4 Environmental Design, Mitigation and Optimization

The features incorporated into the Project design (as described in Section 4) include:

- Known archaeological/heritage resources have been avoided during the routing process.
- Predictive modelling was used to identify areas with an elevated potential for the occurrence of archaeological resources, and to assist in the avoidance of resources.
- The following measures have been recommended to mitigate Project impacts to archaeological/heritage resources.

Field Assessment

Where the new pipeline RoW passes through areas of elevated archaeological potential, or where other Project related ground disturbing activities occur within areas of elevated archaeological potential; prior to construction activities under a provincial archaeological research permit carry out archaeological fieldwork to assess the potential of the Project to impact resources during all phases of the Project, and provide a basis for the recommendation of appropriate mitigative measures, if required.

Develop Protocol

In consultation with regulatory agencies, develop a protocol so that in the event of a archaeological or heritage resource discovery, the proponent, its contractors and regulatory agencies are in agreement as to what course of action will be undertaken to mitigate potential resource impact.

7.5.4.5 Construction

Although there will be construction activities associated with the new pipeline and ancillary facilities, there are no known resources within the RoW or Project footprint. Pre-construction archaeological fieldwork may identify areas that require additional investigation or mitigation. In addition, there is some potential that archaeological/heritage resources may be identified during construction, particularly in areas of elevated potential for archaeological resources.

7.5.4.6 Operation, Maintenance, Decommissioning

During these Project phases there is some potential that archaeological/heritage resources may be identified, particularly in areas of elevated potential for archaeological resources.

7.5.4.7 Monitoring and Follow-up

If the pre-construction archaeological survey of areas of elevated potential identify resources, archaeological monitoring of construction related activities is recommended.

7.5.4.8 Residual Environmental Effects

With implementation of the recommended environmental mitigation initiatives, it is anticipated that significant residual environmental effects are not likely to occur to archaeological/heritage resources.

7.5.5 Traffic Noise

The nearest residences to pipeline construction will be approximately 30 m. Project activities in close proximity to residences have the potential to cause disturbance to occupants through unwanted noise. There are no guidelines in New Brunswick for acceptable noise levels however, the following comparative noise levels (EPRI, 1982) have been used to assess significance:

0 Library 30-40 dBA
1 Living Room 40-50 dBA
2 Office 50-60 dBA
3 Conversation 60-70 dBA
4 Car Horn 110-120 dBA

The Saint John Noise Bylaw forbids noise from construction equipment between 9 p.m. and 7 a.m., which disturbs the peace and tranquility of two or more separate individuals on any street. Potential effects of noise from construction and from operational pumping and booster pump stations, on adjacent residences, are expected to be localized and of small magnitude. Therefore, it is not likely that significant adverse effects will result from Project noise. Construction generated noise will be localized and short-term.

Mitigation

In consideration of the Saint John Noise Bylaw, pipeline construction activities which generate loud noise, will be conducted between the hours of 7 a.m. and 9 p.m.

Residual Effects

With the implementation of the recommended mitigation measures, no significant residual effects will occur.

7.5.5.1 Scope and Boundaries

Noise associated with the Project can be separated into two distinct categories. The first is noise impacts generated at the Noise Sensitive Areas (NSAs) as a result of the construction process. In this case, both construction workers traffic and equipment traffic will generate noise along King William Road, which may impact NSAs in the immediate vicinity. This type of noise generation is short term in nature. The second type of noise is associated with the long-term operation of the highway and the noise generated by traffic to and from Coleson Cove on a regular basis.

Potential effects of noise from construction and from operational pumping and booster pump stations, on adjacent residences, are expected to be localized and of small magnitude. Therefore, it is not likely that significant adverse effects will result from Project noise. Construction generated noise will be localized and short-term.

7.5.5.2 Baseline

The ambient noise levels in the Study Area have been summarized in Section 5.0 and the Component Study: Supplemental Studies.

7.5.5.3 Effects Assessment

The New Brunswick Department of Transportation (NBDOT) highway noise policy is intended to address noise impact associated with two types of highway development. These include new highway corridors and major construction upgrade initiatives. In reality, the Project is not related to any highway initiative. However, the methodologies for measuring and predicting traffic noise impacts are applicable.

The NBDOT noise policy indicates the Department will evaluate the feasibility of attenuating noise where impacts on NSAs are significant. A significant impact is to be interpreted as highway generated noise levels which exceed, or are expected to exceed the provincial noise level objective. To date, the provincial objective has not been defined in terms of an L_{eq} decibel reading.

However, various agencies have established guidelines with respect to traffic noise levels that suggest when mitigation measures should be considered. The Central Mortgage and Housing Corporation (CMHC) guidelines for new home construction recommends the L_{eq} 24 level should not exceed 55 dBA outside of the building face. If these levels are exceeded, CMHC guidelines state that in the 55 dBA to 75 dBA range, this is normally unacceptable unless adequate sound installation is provided to reduce noise levels inside. Outside recreation space may have to be sheltered as well at these levels.

The Transportation Association of Canada indicated in their 1986 design manual that when sound exposure outdoors exceed 60 dBA, mitigation resources for both indoor and outdoor spaces normally are required by various agencies. The Ministry of Transportation and Highways in British Columbia and the Ministry of Transportation in Ontario both utilize the 55 dBA level 10 years after project completion as the criteria for considering mitigation.

The measured and predicted existing 2002 L_{eq} 24 noise levels at each NSA site have been presented in detail in the Component Study: Supplemental Studies, and are summarized in Table 7.33 which shows the difference between the two values. Generally, predicted values which are within 2 dBA of the measured values are considered a good correlation. The human ear can barely perceive a 2 to 3 dBA change in noise levels. A review of Table 7.33 indicates all sites have been modelled to predict noise levels that are within 2 dBA of the measured ambient noise levels, and thus the noise model is validated.

Construction related traffic was considered in the Fuel Delivery Component Study. The pipeline construction is anticipated to be of short duration and will be planned to minimize the effect of noise, with the majority of the traffic activity concentrated along the pipeline corridor. Maximum traffic is estimated to be less than one hundred vehicles/day. Subdivisions will be avoided for access during construction, as there is ample access from other points.

Irving Oil Limited has advised that it is expected construction activities will be conducted on a 5-day work week. However, a 6-day work week might be required at times. The pipeline construction is anticipated to be of short duration
The Red Head Road near its intersection with Bayside Drive is handling approximately 6000 vehicles daily. The volume on Red Head Road nearer Canaport would be substantially less. The Red Head Road should be capable of handling twice the traffic in a day (*i.e.*, at least 12,000 vehicles per day).

The Bayside Drive/Red Head Road intersection is signalized. Therefore, the signal phasings and timings can be adjusted to reflect traffic increases. It should also be noted that the construction traffic in the peak morning and evening would be in the opposite direction to the commuter traffic on Red Head Road

TABLE 7.33 Measured Versus Predicted Existing Ambient Noise Levels (L_{eq} 24) at Selected NSAs

NSA Number	NSA Description	Noise Level		
		Measured (dBA)	Predicted (dBA)	Difference (dBA)
1	Located at the end of Prince Street	63.4	62.3	-1.1
2	Located at 306 Prince Street	65.9	64.9	-1.0
3	Located at 108 Prince Street (Figure 1)	53.6	55.7	+2.1
4	Located at 208 King Street (Figure 1)	53.7	53.3	-0.4
5	Located at 811 Lorneville Road (Figure 2)	48.2	49.2	+1.0
6	Located at 804 Lorneville Road (Figure 2)	45.7	46.7	+1.0
7	Located at the End of Lorneville Road (Figure 2)	49.6	49.5	-0.1

The predicted increase in noise levels above ambient levels due to the Project ranges between 0.4 and 3.9 dBA. This increase will barely be perceivable by the human ear at most NSAs. The noise increases resulting from the Project do not result in any significant impact at the NSAs.

Existing noise levels in the Saint John West area are high because of large existing automobile and truck volumes. There are already high truck volumes associated with the port activity and the Project will add to these volumes. Minimizing the noise impacts of existing and future truck movements could include reduced use of jake brakes by trucks and restriction of truck movements during specific night time hours.

7.5.6 Water Supplies

The probability for impact to wells from pipeline construction is low. The experience of municipal pipeline construction in the City of Saint John indicates that blasting through bedrock is not always required. For example, the Enbridge Gas distribution system was installed without blasting. Mitigation strategies employed for previous Projects have been successful in protecting wells during blasting and dewatering conditions. The Maritimes and Northeast Pipeline (M&NP) Mainline Project (540 km) sampled 300 wells, and received only 14 complaints. The Saint John Lateral Pipeline Project (rural portion), St. George Pipeline, and the Lake Utopia Pipeline (90 km) together received only 4 complaints. These complaints were reported to M&NP due to either water quantity or quality reduction. In all cases these complaints were in relation to shallow, dug wells and were not directly attributable to pipeline construction activities.

The Harbour View subdivision is serviced by a municipal well. The Debly subdivision and other rural housing use private wells.

The exact locations of the private wells in the Study Area are unknown. In order to determine the locations, a pre-construction survey of the houses in the area would be conducted. Once these locations are known, the appropriate mitigation would be put in place to protect these wells during construction of the pipeline.

IOL has advised that they are initiating their studies into the potential pipeline route. IOL has assured NB Power that protection of water supplies, both private and municipal, will be factored into their planning for the new pipeline, as has been done successfully on other recent pipeline projects.

7.5.7 Economic Consequences of the Project

Environmental effects associated with air emissions and marine traffic, both normal and accidental are predicted to be much lower with Orimulsion® that the existing case with Fuel Oil #6. The Project will require a small area of undisturbed land for the SWSDA, whereas, the pipeline will primarily occupy existing RoW and the pollution abatement equipment will be installed within the existing confines of the CCGS. Therefore, there is anticipated to be a net environmental benefit associated with the Coleson Cove Project.

Similarly, with respect to human health, investigations have concluded that there is a net reduction of already low health risks, associated with the Project. Therefore, there would be a net economic health benefit associated with the Project.

Finally, from a socio-economic perspective, there are overall major positive effects on the local and provincial economies during construction and operation of the facility.

7.6 Human Health Risk Assessment

7.6.1 Introduction

This section presents a Multipathway Human Health Risk Assessment of the CCGS in Saint John County, New Brunswick, operated by NB Power. The CCGS currently generates electricity by burning heavy fuel oil (Fuel Oil #6) as an energy source. This comprehensive risk assessment estimates potential risks to human health associated with direct and indirect exposure to emissions from the CCGS under three sets of conditions:

- The Existing Condition - Fuel Oil #6 - High Load Scenario, in which the Facility continues to use heavy fuel oil as an energy source;
- The Refurbishment Project - Orimulsion® - High Load Scenario, in which the Facility is assumed to use Orimulsion® as an energy source; and
- The Natural Gas - High Load Scenario, in which the Facility is assumed to use natural gas as an energy source.

Unlike the Air Quality Report (JWEL, 2002), which evaluates the facility operating at low, medium, and high capacity factors for each fuelling scenario, the health risk assessment evaluates risks solely assuming the maximum capacity factor. This is done intentionally to ensure that health risks are overestimated and the results are health protective. The term "high load scenario" as used in this report means that it is assumed that the CCGS operates 24 hours a day, 365 days a year at maximum capacity. Actual operating conditions are much lower because of variability of system energy requirements and the need for periodic maintenance activities.

Estimates of the potential carcinogenic risks (that is, the chance of developing cancer) and noncarcinogenic risks (that is, the likelihood that toxic health effects other than cancer may occur) are made and presented for several types of exposures to emissions from the facility.

The risk assessment guidance requires that risks be evaluated for three groups of people (residents, farmers, and fishers) who may or may not actually live in the Study Area around the facility that is the subject of the risk assessment. This is required so that all of the ways that facility emissions could affect human health are evaluated. The guidance requires that these groups of people are assumed to be located in areas defined as locations of maximum impact where it is reasonable to anticipate that they could be exposed to facility emissions.

After evaluating the results of the air dispersion and deposition modelling, AMEC identified a location directly adjacent to the property boundary as the location for the maximally affected hypothetical resident (a recreational fisher) and a location northwest of the City of Saint John as the location for the maximally affected hypothetical farmer. In addition, the City of Saint John was identified as another location for which risks would be evaluated for residents and recreational fishers. Each of these groups of people are called "receptors" in this risk assessment. The five receptors identified are summarized as follows:

- resident living at the hypothetical residential area most affected by the facility;
- resident living in the City of Saint John;
- resident living at the hypothetical residential area most affected by the facility who fishes recreationally;
- resident living in the City of Saint John who fishes recreationally; and
- farmer living at the farm most affected by the facility.

For each of these receptors, both adults and children were separately evaluated. It was assumed that each of the receptors could be exposed through various direct pathways (such as inhalation of air containing emissions from the facility) and indirect pathways (such as consumption of food products or water that have been exposed to facility emissions).

Exposures to facility emissions were calculated using numerous conservative (upper-bound) exposure assumptions that tend to overstate potential risks. Therefore, the potential risks calculated in this risk assessment do not represent actual risks to people living near the CCGS, but rather represent the reasonable upper-bound estimates of risk to hypothetical receptors assumed to engage in all activities that may result in exposures to facility emissions.

7.6.2 Risk Assessment Methodology

This risk assessment followed the four step method developed by the National Research Council of the US National Academy of Sciences and routinely used by Canadian regulatory agencies. The four steps are:

- Hazard Identification;
- Toxicity Assessment;
- Exposure Assessment; and
- Risk Characterization.

The methods and results of each of the four steps of the risk assessment are summarized in the following paragraphs. The methodology used to estimate potential exposures and risks is consistent with guidance from US EPA (1998a, 1999, 2000).

7.6.2.1 Hazard Identification

The compounds to be quantitatively assessed in the risk assessment are selected in the Hazard Identification step. The compounds expected to be emitted from the CCGS depend upon the type of fuel used at the facility. Compounds of potential concerns were identified for each set of operating conditions based upon measurements of compounds in fly ash from emissions from the CCGS, measurements of compounds in fly ash from emissions from similar facilities, measurements of compounds in fly ash from emissions from a facility using Orimulsion® as fuel, US EPA sources, and other literature sources. Each compound expected to be emitted from the facility was evaluated for its potential to pose a threat to human health. The factors taken into consideration in this process are the maximum amount of the compound expected to be released, its toxicity, and its mobility and persistence in the environment. A subset of compounds was then selected for inclusion in the quantitative risk assessment. An average emission rate was then estimated for each of these compounds based on fly ash measurements, facility emission measurements, engineering calculations, air pollution control equipment specifications, US EPA AP-42 default emission factor tables, and/or information gathered from the scientific literature.

In order to estimate air concentrations of the compounds of potential concern in the region around the CCGS, air dispersion modelling (see Section 7.2) was conducted using standard, conservative models in accordance with standard US EPA guidelines, which are routinely used by Canadian regulatory agencies. These models take into account emission rates, physical properties of the emitted compounds and local weather data to predict the 5-year average air concentrations. The results were used to provide the air concentration data used to evaluate the various receptor locations.

Deposition modelling was performed using the results of the air dispersion modelling and meteorological data to describe the behavior of compounds associated with particles in the air that deposit on soils or water bodies. Additional modelling was performed to predict compound concentrations in soils and surface waters resulting from deposition, runoff, and other environmental fate and transport processes.

7.6.2.2 Toxicity Assessment

In order to determine if exposures to the compounds of concern may potentially result in adverse human health effects, it is necessary to have a numerical estimate of the toxicity of each compound of potential concern. The toxicity assessment identifies the types of adverse health effects a compound of potential concern may potentially cause and defines the relationship between the dose of a compound and the likelihood or magnitude of an adverse effect (dose-response). Adverse effects are characterized as carcinogenic or noncarcinogenic. Dose-response relationships are defined for oral exposure and for exposure by inhalation.

Noncarcinogenic effects are those other than the potential to cause cancer. They encompass a wide variety of effects that range from body weight changes to more serious effects such as liver or kidney toxicity. Compounds with noncarcinogenic effects are assumed by regulatory agencies to have a dose, called the threshold, below which no adverse effect occurs or, conversely, above which an adverse effect may be seen. Noncarcinogenic dose-response values define a safe level of exposure for humans. The incorporation of safety factors into the derivation of the safe level provides reasonable certainty that the safe dose is below the threshold dose and that no noncarcinogenic health effects are expected to occur, even if daily exposure to that dose were to occur for a lifetime to especially sensitive members of the population.

The conservative underlying assumption of regulatory risk assessment for compounds with known or suspected potential carcinogenic effects is that no threshold exists. In other words, it is assumed that a finite level of risk is associated with any dose above zero. The regulatory agencies have developed computerized models that estimate the carcinogenic potency of a compound. This numerical estimate is referred to as a cancer slope factor.

In this risk assessment, the relationship between the dose of a compound and the likelihood and magnitude of an adverse effect was determined for each compound included in the quantitative risk assessment. Both potential carcinogenic and potential noncarcinogenic effects were considered in the risk assessment. Dose-response information used in the risk assessment was identified from Canadian and US government sources.

7.6.2.3 Exposure Assessment

The results of the various modelling tasks performed in the Hazard Identification step provide estimates of the concentrations of the compound of potential concerns in air, soil, surface water, and food products as a result of facility emissions. These concentrations are used to predict receptor exposure to the compounds.

To estimate potential human exposure to compound of potential concerns, potential exposure pathways were defined for each receptor. Potential exposure pathways describe ways in which receptors may be exposed to compound of potential concern in the various environmental media.

For each of the receptors identified in this risk assessment, it was assumed that exposure could occur through the following direct and indirect pathways:

- inhalation of emissions from the facility;
- incidental ingestion of soil while working or playing outdoors;
- ingestion of produce grown in backyard gardens or farms;
- ingestion of fish caught from Spruce Lake, Ludgate Lake, and Menzies Lake;
- consumption of food products (beef, dairy, pork, poultry, and eggs) from a local farm; and
- drinking water exposure to water from the Spruce Lake Reservoir.

For each fueling scenario, compound concentrations present at each receptor location (hypothetical maximum residence, City of Saint John, farm, and Lakes) were estimated using conservative (health-protective) assumptions. In addition, conservative assumptions were also made about the magnitude of each exposure, such as the quantity of soil or fish that is ingested on a daily basis. The use of many upper-bound factors in calculating potential risks results in an estimate that tends to overstate actual risks, if any, which may occur as a result of receptors' potential exposure to facility emissions.

7.6.2.4 Risk Characterization

The potential exposure dose for each receptor from each compound via each route of exposure was combined with the appropriate dose-response value for that compound in order to estimate the potential for adverse health effects.

In the risk characterization process, to evaluate if potential noncarcinogenic effects may occur due to exposure to compound of potential concerns, the ratio of the receptor's exposure dose to the noncarcinogenic dose-response value is calculated for each compound of potential concern. This ratio is termed the hazard quotient. If the hazard quotient ratio is less than one, no adverse noncarcinogenic health effects are expected to occur as a result of exposure to that compound via that route of exposure. The hazard quotient for each pathway by which each receptor is assumed to be exposed are summed to yield a hazard index for that compound. A total hazard index is then calculated for each receptor by summing the compound-specific hazard indices for that receptor for each toxicity endpoint for which it is appropriate to sum the effects of several compound of potential concerns. A total hazard index of less than one for a given receptor for each toxicity endpoint provides further evidence that no adverse noncarcinogenic health effects are expected to occur as a result of that receptor's potential exposure to environmental media given the emission rates and exposures assumed in the risk assessment. As a screening step, hazard quotients for all chemicals are summed to determine if it is necessary to calculate toxicity endpoint-specific hazard indices. If the total hazard index is less than one, then hazard indices for each toxicity endpoint are not necessary.

The purpose of carcinogenic risk characterization is to estimate the likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of exposures to compound of potential concerns in environmental media due to facility emissions. The product of the exposure dose of a compound via a particular pathway times the cancer slope factor for that compound is a unitless value. It provides an estimate of the potential carcinogenic risk associated with a receptor's exposure to that compound via that pathway. This value is termed the excess lifetime cancer risk. The excess lifetime cancer risk for each compound is calculated by summing the excess lifetime cancer risk values for each pathway by which the receptor is assumed to be exposed. The total excess lifetime cancer risk for each receptor is calculated by summing the compound- and pathway-specific excess lifetime cancer risks. Excess lifetime cancer risks are compared to a target risk of 1×10^{-5}, or one excess cancer case per 100,000 people exposed. An excess lifetime cancer risk for a compound that is less than the target risk of 1×10^{-5} is considered less than the regulatory level of concern. A total excess lifetime cancer risk for a receptor that is less than the target risk of 1×10^{-5} provides further evidence that the receptor's potential exposure to facility emissions will not result in unacceptable cancer risk.

For each of the three fueling scenarios, the compound-specific hazard index for each compound of potential concern is below 1 for each receptor. The total hazard index for all compounds of potential concern is also below 1 for each receptor, and the toxicity endpoint-specific hazard index is also below 1 for each receptor. The compound-specific carcinogenic risk for each compound of potential concern is less than 1×10^{-5} for each receptor. The total carcinogenic risk for all compounds of potential concern is less than 1×10^{-5} for each receptor.

Table 7.34 shows the estimated total excess lifetime cancer risk and total hazard index for each receptor evaluated for each operating scenario.

Cancer risks estimated by this risk assessment for all three fueling scenarios are all so low that they are immeasurable and can be considered to be indistinguishable from each other. Although the numerical estimates can be shown in the various tables to be different numbers, some of which are lower than others, they are so low that any differences between them have limited, if any, significance. According to the Atlantic Health Sciences Corporation (2001), the

TABLE 7.34 Summary of Carcinogenic and Noncarcinogenic Risk Estimates for Non-Criteria Pollutants

Scenario	Receptor	Total Excess Lifetime Cancer Risk	Total Hazard Index*
Existing Condition – Fuel Oil #6 – High Load Scenario	Maximum Location Child Resident	$7x10^{-8}$	0.17*
	Maximum Location Adult Resident	$1x10^{-7}$	0.08
	Saint John Child Resident	$7x10^{-8}$	0.08*
	Saint John Adult Resident	$2x10^{-7}$	0.04
	Maximum Location Child Fisher	$8x10^{-8}$	0.18*
	Maximum Location Adult Fisher	$2x10^{-7}$	0.12*
	Saint John Child Fisher	$8x10^{-8}$	0.09*
	Saint John Adult Fisher	$3x10^{-7}$	0.12*
	Child Farmer	$6x10^{-8}$	0.08*
	Adult Farmer	$1x10^{-7}$	0.04
Refurbishment Project – Orimulsion® – High Load Scenario	Maximum Location Child Resident	$7x10^{-9}$	0.02
	Maximum Location Adult Resident	$1x10^{-8}$	0.009
	Saint John Child Resident	$1x10^{-8}$	0.01
	Saint John Adult Resident	$5x10^{-8}$	0.007
	Maximum Location Child Fisher	$8x10^{-9}$	0.04
	Maximum Location Adult Fisher	$2x10^{-8}$	0.03
	Saint John Child Fisher	$2x10^{-8}$	0.03
	Saint John Adult Fisher	$6x10^{-8}$	0.03
	Child Farmer	$1x10^{-8}$	0.01
	Adult Farmer	$4x10^{-8}$	0.006
Natural Gas – High Load Scenario	Maximum Location Child Resident	$2x10^{-10}$	$5x10^{-6}$
	Maximum Location Adult Resident	$4x10^{-10}$	$1x10^{-6}$
	Saint John Child Resident	$8x10^{-11}$	$1x10^{-6}$
	Saint John Adult Resident	$3x10^{-10}$	$5x10^{-7}$
	Maximum Location Child Fisher	$6x10^{-10}$	$3x10^{-4}$
	Maximum Location Adult Fisher	$3x10^{-9}$	$3x10^{-4}$
	Saint John Child Fisher	$4x10^{-10}$	$3x10^{-4}$
	Saint John Adult Fisher	$3x10^{-9}$	$3x10^{-4}$
	Child Farmer	$1x10^{-9}$	$2x10^{-5}$
	Adult Farmer	$3x10^{-9}$	$1x10^{-6}$

* Footnoted result is the maximum toxicity endpoint-specific hazard index.

population of the City of Saint John in 2000 was 72,269. The estimated excess lifetime cancer risk from this risk assessment that would be equivalent to one additional case of cancer in Saint John over a year is $4.1x10^{-4}$. The estimated excess lifetime cancer risk from this risk assessment that would be equivalent to one additional case of cancer in Saint John over the course of a 30-year period is $1.4x10^{-5}$. Clearly, any estimated risk level that is less than $4.1x10^{-4}$ is not measurable over a year, and any risk level that is less than $1.4x10^{-5}$ is not measurable over 30 years.

According to Atlantic Health Sciences Corporation (2001), cancer incidence rates for the City of Saint John were 218 cases (total cancers) in 2001 in males and 195 cases (total cancers) in females in 2001. The total number of cases was thus 413 out of a population of 72,269. If the estimated excess lifetime cancer risk from this risk assessment for any fueling scenario was 4.1×10^{-4} or higher, then one would predict that this number of cancer cases would increase from 413 to 414 cases in the population in a year. However, no estimated lifetime cancer risk was higher than 3×10^{-7}. Thus, the predicted increase in cancer cases per year would be from 413 cases to 413.0007 cases. This increase in risk is not measurable.

Over the course of the assumed period of operation of 30 years, there will continue to be cases of cancer in Saint John due to the many causes of cancer. If it is assumed that the cancer incidence rate due to all sources remains constant and the population remains constant, one can predict that the number of cases of cancer over 30 years will be 413 x 30 = 12,390. If the estimated excess lifetime cancer risk from this risk assessment for any fueling scenario was 1.4×10^{-5} or higher, then one would predict that this number of cancer cases would increase from 12,390 to 12,391 cases in the population over the course of 30 years. Such a risk, although small, would be measurable. However, no estimated lifetime cancer risk was higher than 3×10^{-7}. Thus, the predicted increase in cancer cases over 30 years would be from 12,390 cases to 12,390.02 cases. This increase in risk is also not measurable.

Noncancer risks estimated by this risk assessment for all three fueling scenarios are all so low that they are indistinguishable from each other. Although the numerical estimates for hazard quotients and hazard indices can be shown in the various tables to be different numbers, some of which are lower than others, they are so low that any differences between them have limited, if any significance.

All tolerable daily intakes and reference doses, which are levels of a chemical to which a person can be exposed every day for their entire lifetime without experiencing an adverse health effect, are derived with many safety factors. Thus, a hazard index over 1.0 would exceed a regulatory level of concern, but it would not exceed a level at which adverse effects have ever been demonstrated in either animals or humans.

For instance, the arsenic hazard quotient for the fisher child receptor at the maximum hypothetical residential location for the Existing Condition – Fuel Oil #6 – High Load Scenario is 0.002. This value is 500 times lower than the tolerable daily intake. However, the tolerable daily intake was derived from a no effect level in humans divided by an additional safety factor of 3. The estimated dose for this receptor is, in fact, 25,000 times lower that the lowest dose level that was shown to cause adverse effects on the skin of humans exposed to arsenic in drinking water.

Similarly, the vanadium hazard quotient for this receptor is 0.18. This value is 6 times lower than the tolerable daily intake. However, the tolerable daily intake was defined as 100 times lower than the lowest dose in an animal experiment where no adverse effects were seen, even in the animals given a 10-fold higher dose of vanadium. The estimated dose to the fisher child at this location is, in fact, over 5,000 times lower than the dose level in the animal experiment where no adverse effects were seen.

As well, the mercury hazard quotient for the child fisher receptor at this location is 0.09. This value is 11 times lower than the tolerable daily intake. However, the tolerable daily intake was defined as 1,000 times lower than the lowest dose in an animal experiment that resulted in adverse effects on the animals. The estimated dose to the fisher child is, in fact, over 10,000 times lower than the dose level in the animal experiment that caused adverse effects.

The tolerable daily intakes and reference doses are defined by regulatory agencies to be intentionally very health-protective. The agencies assume that all dose levels within 10 fold of an effect level could also have adverse effects. They assume that humans are more sensitive to the chemical compared to animals in all cases, by a factor of 10. They always assume that some sensitive human subpopulations are 10-fold more sensitive than other humans. All of these assumptions are made so that estimated doses of chemicals from risk assessments that yield hazard quotient estimates less than 1.0 are certain to be totally devoid of risk. In addition, if the hazard quotient is less than 1.0, the additional margin of safety addresses the concern that is sometimes raised that people may be exposed to background levels of the chemical from other sources. In this case, the highest toxicity endpoint-specific hazard index is 0.18, which means that even if background exposures were five times higher than the facility-related exposures, the regulatory level of concern hazard index of 1 would still not be exceeded. Thus, all hazard index estimates from this risk assessment are essentially indistinguishable. In all cases, there is a high degree of certainty that no adverse effects will occur.

For instance, the hazard index for all chemicals combined for the resident child assumed to live in Saint John for the Refurbishment Project – Orimulsion® – High Load Scenario is 0.01. This is 100 times lower than the noncancer benchmark of 1. No endpoint specific hazard index exceeds 0.008, which is 125 times lower than the benchmark of 1. In this case, there is a high degree of certainty that no adverse effects will occur. For the same receptor, the Natural Gas - High Load Scenario gives a total hazard index summed over all chemicals of 1×10^{-6}, which is far lower than the benchmark of 1, but these two results are, in fact, indistinguishable given the manner in which tolerable daily intakes are derived. Noncancer risk is inversely proportional to hazard index as the hazard index drops from high values down to the benchmark of 1.0. However, once the estimated hazard index drops to levels below the benchmark level of concern, the differences in the hazard index are no longer distinguishable from one another.

In conclusion, for both carcinogenic and noncarcinogenic risk, the risks for all three scenarios are low enough that they should be viewed as essentially indistinguishable from each other in terms of a direct comparison to regulatory decision-making criteria. Reducing risks to levels below regulatory levels of concern can be viewed as adding societal benefits, to a point, because reduction of carcinogenic and noncarcinogenic risks to levels beyond required regulatory levels can decrease the uncertainty that is inherent in the risk estimation process.

Thus, if one scenario has an estimated risk that is ten-fold below the regulatory level of concern, there is a societal benefit to choosing a second scenario that has an estimated risk that is 100 times below the regulatory benchmark, because one has increased certainty that if important factors were inadvertently left out or underestimated, the true result is more likely to still be acceptable if the margin of safety is greater for the second case. However, this increase in certainty cannot be extended *ad infinitum*. At some point reasonable people who evaluate the conservativeness of the risk assessment process, which has many safety factors inherently built into it, will have to conclude that an *additional* safety factor is simply not necessary. By this logic, one can conclude that reducing cancer risk from $1x10^{-7}$ to $1x10^{-8}$ can be viewed as having a public health benefit given a regulatory level of concern of $1x10^{-5}$, but reducing it to $1x10^{-10}$ provides no tangible benefit.

This is the situation with the three fueling scenarios. Reducing the estimated cancer risk from 0.03 cases in 100,000 for the Existing Condition - Fuel Oil #6 – High Load scenario to 0.006 cases in 100,000 for the Refurbishment Project - Orimulsion® - High Load Scenario can be viewed as conferring a societal benefit in terms of reducing any uncertainty inherent in the risk assessment. In the first case, the additional margin of safety (over and above the margins of safety that are built into the risk assessment process) that the regulatory goal was met was 33-fold. In the second case, the additional margin of safety is 166-fold. Further reducing the estimated cancer risk to 0.0003 cases in 100,000 for the Natural Gas - High Load Scenario may indeed increase the margin of safety further, but attaining this additional reduction in risks does not equate to a proportionally increased benefit, because the result is already so far beyond the regulatory goal.

7.6.3 Risk Characterization of Criteria Pollutants

Estimated annual average concentrations of sulphur dioxide, nitrogen oxides, and respirable particulate matter were compared to the measured levels in Saint John and to the governmental standards. The CCGS is not a major source of sulphur dioxide, nitrogen dioxide, PM_{10}, or $PM_{2.5}$ in the City of Saint John, nor would it be if the refurbishment project were executed. Neither estimated concentrations resulting from the CCGS nor the existing ambient concentrations that result primarily from sources other than the CCGS exceed standards derived to protect human health. Nonetheless, the CCGS may be responsible for a fraction of the ambient concentrations in the City of Saint John. If the refurbishment project were executed, the contribution of the CCGS to the concentrations in Saint John would drop, so the ambient concentrations in Saint John would also drop assuming that no other sources were increased. This estimated drop the concentrations of criteria pollutants must be viewed as a health benefit.

However, since the CCGS is not a major source of these criteria pollutants in the City of Saint John, the predicted decreases in concentrations of criteria pollutants are modest and may be difficult to measure. For instance, assuming that the average concentration of sulphur dioxide in Saint John is 18 micrograms per cubic meter of air ($\mu g/m^3$), which is the average of the Forest Hills and the Prince William Street measurements from 1995-2000, the average concentration is estimated to drop from 18 to 17.5 $\mu g/m^3$. The estimated additional improvement in air quality assuming that the CCGS used natural gas as fuel would result in an estimated concentration of 16.5 $\mu g/m^3$.

Similarly, assuming that the average concentration of nitrogen oxides in Saint John is 14.5 $\mu g/m^3$, which is the average of the Forest Hills and the Prince William Street measurements μfrom 1995-2000, the average concentration is estimated to drop from 14.5 to 14.4 $\mu g/m^3$. The estimated additional improvement in air quality assuming that the CCGS used natural gas as fuel would result in an estimated concentration of 14.2 $\mu g/m^3$. For respirable particulate matter, the CCGS is estimated to contributed only 0.1% to the concentrations of PM_{10} and $PM_{2.5}$ in the City of Saint John. Thus, the estimated improvements in the concentrations assuming that the refurbishment project is executed are probably not measurable.

7.6.4 Qualitative Risk Characterization

The risk assessment has reviewed and evaluated data and information on the health status of people residing in the Study Area and the recent scientific research showing associations between air pollution and cardiorespiratory diseases. It was found that lung cancer appears to be elevated in the City of Saint John compared to the province and the nation, but lung cancer rates are lower in the Saint John area compared to the province and the nation. Asthma does not appear to be elevated in Saint John. The status of other respiratory diseases is unclear, because various statistical measures are not consistent. Smoking rates have been shown in a variety of statistical sources to be elevated in Saint John compared to the province and the nation, and this information should be considered when cancer rates are evaluated.

Several epidemiology studies have been performed in Saint John to determine if the variability in adverse respiratory or cardiac health effects might be associated with variability in air pollutant concentrations. In one study, asthma emergency department admissions were found to be statistically significantly associated with ozone levels. No effects of particulate matter were shown. In another, the number of emergency department admissions for respiratory diseases was shown to be associated with smoking and viral upper respiratory tract infections. Lastly, other researchers studied emergency department admissions for respiratory and cardiac diseases and found that ozone and sulphur dioxide could explain the variability in admissions.

No effects were seen for respiratory particulate matter in multipollutant analyses. Fungal spores were also associated with adverse health effects during warm months.

In conclusion, the studies performed in Saint John provide little support for the hypothesis that the variability in the rates of adverse health outcomes is attributable to the variability in the concentration of respiratory particulate matter, such as PM_{10} or $PM_{2.5}$. Studies performed elsewhere in Canada and the United States have shown that part of the variability in health outcome rates may be associated with varying rates of particulate matter concentrations, but the Saint John studies differ in their conclusions from these other studies. The conclusions of the Saint John studies point to ozone, sulphur dioxide, fungal spores, and smoking as potential causes of respiratory and cardiac disease.

However, based on a review of studies performed in Canada and the United States, it can be stated that reductions in ambient concentrations of one or more of the following air pollutants (ozone, sulphur dioxide, nitrogen dioxide, carbon monoxide, and respirable particulate matter

[$PM_{2.5}$ and PM_{10}]) could be expected to confer health benefits to residents of Saint John. These benefits would be associated with decreases in hospitalizations for asthma and other respiratory diseases, hospitalizations for cardiac diseases, and mortality from cardiorespiratory diseases.

Even though the decrease in air pollutant concentrations that are estimated to occur when the CCGS is refurbished are expected to have a beneficial effect on human health, there is no way to quantitatively predict the number of cases of each health outcome that will be prevented. This human health risk assessment has predicted the differences in carcinogenic and noncarcinogenic health risk for selected metals, polycyclic aromatic hydrocarbons, and volatile organic chemicals, because there are standard risk assessment methodologies developed by government health protection agencies to do so. Such methods have been widely used for environmental decision making for over 25 years. However, no such methods exist for estimating the number of hospitalizations for asthma, chronic obstructive pulmonary disease, or cardiovascular disease or other similar health outcomes. Based on the accompanying review of recent scientific studies, one can make only qualitative conclusions about the improvement of the health status of residents of Saint John expected with the refurbishment.

In addition, although it may be reasonable to assume that some asthma and cardiorespiratory symptoms and disease outcomes are caused by air pollution, these diseases are multi-causal. Asthma researchers believe that exposure to specific allergens, such as those associated with pollens, fungi, dust mites, insects and pet dander, and environmental tobacco smoke are the major causes of asthma. Of course, outdoor air pollution is recognized to exacerbate asthma symptoms, as are other environmental factors, such as exposure to fragrances and household cleaning products, viral infections, exercise, and cold air. Similarly, chronic obstructive pulmonary disease is associated with smoking in addition to air pollution. Thus, reduction of emissions of sulphur dioxide, nitrogen dioxide, respirable particulate mater, and specific chemicals associated with the particulate matter will reduce the concentrations of some of the agents that can cause or exacerbate cardiorespiratory diseases.

This must be viewed as a benefit to the public health. However, the causationof these diseases and the triggering of their acute symptoms are extremely complex phenomena that cannot be explained in totality. Thus, decreases in the emissions from CCGS may ormay not translate into a measurable decrease in the number of new cases of cardiorespiratory diseases, the number of cardiorespiratory hospitalizations, the number of asthma attacks in children, or any other such similar health outcomes. The causation of these diseases is toocomplex to make any such quantitative predictions. Nonetheless, reductions in the emissions of respirable particulate matter and other criteria pollutants must be viewed as a public health benefit.

7.6.5 Construction Traffic Impacts

An estimated 1679 passenger vehicles will arrive or leave the construction site each day, most of which will be in the morning and afternoon peak hours. Almost 50 truck trips will be generated with this traffic arriving randomly throughout each workday.

There will be a noticeable level of service and safety impact generated by the influx of construction workers in the morning peak hour during the highest activity period of the construction phase. The traffic problem will be located at the intersection of the westbound Route 1 off-ramp at King William Road. The high demand posed by the construction workers heading into Coleson Cove from Saint John during the morning peak will result in unacceptably long delays to make the left turn onto King William Road. This could result in traffic backing up onto the westbound lanes of Route 1, which would create a safety hazard. No other significant negative safety impacts, however, should be experienced on the Study Area highway network

With respect to the infrastructure impacts, all segments should be capable of handling the traffic increase, including the truck movements.

7.6.6 Operations Traffic Impacts

Operations traffic will include the additional trucks and passenger vehicles generated by the expanded operations at the CCGS. Operations generated traffic will be distributed more or less evenly throughout each day and each year, and will recur each year until closure of the CCGS. The net total traffic generated by the expanded operations will average 261 vehicles per day leaving and arriving at the CCGS. Of this daily workweek traffic, 144 vehicles will be trucks and 117 will be passenger vehicles.

The Study concluded that once the refurbishment work is completed there will be no significant traffic levels of service or safety impacts from the enhanced operations at the Coleson Cove Generating Station. In addition, there will be no significant impacts on the highway infrastructure from the additional traffic during construction, or thereafter when fully operational. The existing highways within the Coleson Cove traffic impact area are constructed to high design standards and are capable of withstanding the impact of the heavy trucks generated during both construction and operations.

7.6.7 Mitigation

To address the level of service and safety issues associated with a large influx of construction workers in the morning to the CCGS it is recommended temporary traffic signal lights at the intersection of the Route 1 westbound ramps and King William Road/Ocean West Way be installed during the construction period. Signalization will permit a separate left turn phase to accommodate the influx of construction workers all arriving to work during the same short period of time in the morning.

7.6.8 Residual Effects Assessment

There will be no significant traffic levels of service or safety impacts from traffic generated during refurbished CCGS operations. Nor will there be any significant impacts on the highway infrastructure or problems encountered in accommodating construction or operations truck traffic on the highway segments within the Coleson Cove traffic impact area.

7.7 Sustainability

Over the past several years, a number of concepts have been developed to encompass important environmental issues. These concepts include sustainable development and biodiversity. This section summarizes NB Power's commitment to these concepts, and demonstrates how these principles have been applied with respect to this Environmental Impact Assessment.

7.7.1 Scope

The definition of sustainable development from the *Canadian Environmental Assessment Act* (CEAA) is "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs".

Biological diversity, or biodiversity, is the total variety of all living things in a particular area or region. Biodiversity is defined as "...the variability among living organisms from all sources, including, *inter alia*, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems" (Environment Canada 1995). This includes genetic diversity, diversity among species, and diversity among the communities and ecosystems in which they occur. Genetic diversity refers to the variation of genes within and among populations of a species. Species diversity refers to the variety and abundance of different types of organisms within a region. Ecosystem diversity refers to the variety of ecosystems or habitats within a region. For the purpose of this assessment, biodiversity has been considered at the species and ecosystem (habitat) levels.

The objectives of the "Convention on Biological Diversity", signed by Canada in 1992, are to conserve biodiversity, to use biological resources in a sustainable manner, and to share benefits resulting from the use of genetic resources. The Convention recognizes environmental assessment as an important decision-making tool for the protection of biodiversity. Canada issued the Canadian Biodiversity Strategy in 1995 in response to the Convention. This document establishes the guiding principles and goals which Canada will encourage to meet the obligations of the Convention.

Biodiversity is not an isolated concept, but a part of project planning (mitigations and monitoring), environmental effects analysis, and consideration of sustainability. NB Power has applied this concept in carrying out scoping, effects analysis, Project design and mitigation, determination of effects significance, and monitoring. This concept is integrated both implicitly and explicitly throughout this EA.

7.7.2 Sustainable Development

NB Power, as a member of the Canadian Electricity Association (CEA), is dedicated to the principles of sustainable development. As an active member of CEA, NB Power shares in the industry challenge to achieve Sustainable Power Generation, which is defined as ensuring energy and environmental sustainability while maintaining sound business practices in an increasingly competitive market.

CEA has developed a set of Principles of a Sustainable Electricity Policy (CEA, 2002 – Electricity and Climate Change – Towards a Sustainable Future). These are summarized below, along with a commentary on initiatives taken by NB Power.

- No fuel or technology can be overlooked in a plan for a sustainable electricity future. NB Power considers the full range of options in planning to meet electricity supply needs, including new and emerging technologies. NB Power actively supports initiatives to develop and apply new electric power generation technologies, for example potential wind energy development.
- No single technology or fuel offers a panacea for new supply and emission reduction. For example, a large-scale shift to natural gas would expose Canadians to increased price volatility. Fuel price variations, environmental issues, regional diversity and other considerations, combine to make a multi-fuel, multi-technology strategy most prudent. NB Power is one of the leaders in Canada in the application of such a strategy.
- A diverse generation mix that is grounded in regional resources and opportunities, and backed by robust transmission and distribution systems will best serve the needs of Canadians in all regions for reliable, affordable low environmental-impact electricity. NB Power has a strong and diverse mix of generation sources, interconnected through a highly reliable transmission and distribution system.
- Regional equity and efficiency must be carefully considered in determining the timing and path of emission reductions. NB Power uses this principle when developing its emission control strategies.
- The policy should adopt a comprehensive multi-pollutant approach to emission reductions. NB Power is committed to reducing NOx, SO_2, PM and other parameters consistent with regulatory targets and timetables.

NB Power participates actively in the Environmental Commitment and Responsibility (ECR) Program of CEA. This industry –wide initiative is an opportunity for electric utilities to report on their environmental performances in a national context. The principles of the ECR program are:

- To be more efficient in our use of resources
- To reduce the adverse environmental impact of our business
- To be accountable to our consumers
- To ensure that our employees understand the environmental implications of their actions and have the knowledge and skills to make the right decisions.

As stated in its Corporate Environmental Policy, NB Power is committed to the achievement of excellence and innovation in protecting the environment of the province, while meeting its mandate to provide economic and reliable energy to the people of New Brunswick. An essential ingredient of that commitment has been the implementation of an Environmental Management System (EMS) Program within the company. NB Power's EMS provides a structured and systematic approach to managing environmental issues. The EMS programs are based on the international ISO 14001 standard and focus on continual improvement through planning, implementation, auditing, corrective action and management review. By providing an auditable framework, the EMS programs ensure there are common environmental goals with defined accountabilities and performance measures.

7.7.3 Sustainability and Energy Policy

The NB 2001 Energy Policy (page i) is described as an

"exercise in striking a balance among competing goals, including:

- *ensure a secure, reliable and cost effective energy supply for residential, commercial and industrial users*
- *promote economic efficiency in energy systems and services,*
- *promote economic development opportunities,*
- *protect and enhance the environment, and*
- *ensure an effective and transparent regulatory regime*".

The Project is consistent with these goals, in the following ways:

- As confirmed through the PUB process, the refurbishment of Coleson Cove and conversion to Orimulsion® is considered to be the low cost option for maintaining a secure and reliable supply of energy for users in New Brunswick.
- As the low cost option among a series of energy alternatives, it meets the criteria of being economically efficient.
- The project provides opportunities for local consulting companies, manufacturing companies, local trades, as well as providing possible opportunities for supply of limestone, and possible new opportunities to managing gypsum.
- The project is a major part of provincial efforts to reduce sulphur dioxide emissions, control nitrogen oxide emissions, and reduce potential environmental concerns within the local airshed.
- The project is undergoing a very transparent and inclusive regulatory review process, involving both the PUB, and a full environmental assessment.

Based on these considerations, NB Power is confident that the Project is in harmony with the Province of New Brunswick Energy Policy.

7.7.4 Biodiversity and Sustainability Assurance

Three of the VECs considered in this EA comprise renewable resources (*i.e.*, resources which will return to a natural state over time) as follows:

- Air quality in the airshed surrounding the Project;
- Marine Ecosystem of the Bay of Fundy; and
- Terrestrial/ Wetlands and Freshwater ecosystems proximate to the pipeline route and the Solid Waste Management site.

Of special concern are the species and populations which sustain and support the needs of present and future generations, *i.e.*, fishery resources, migratory birds, marine mammals, and productive wetland habitat.

It is a requirement of *CEAA* to consider the capacity of renewable resources to meet present and future needs. Presently, all of the VECs identified above are managed by the Provincial and Federal agencies, which allow sustainable harvesting/usage of VECs such as hunting and fishing.

Based on the assessment of Project and cumulative effects, no significant adverse residual effects are predicted to occur for any of the VECs, with application of the identified mitigation. Within the local and regional context, a significant effect was considered to diminish the quality of the renewable resource, critically reduce the availability of the renewable resource, or compromise the ability of other species or future generations to meet their needs. Since no significant adverse effects are anticipated, the capacity of the renewable resources identified above to meet present and future needs is considered to be unaffected by the Project. Therefore, no additional mitigation is necessary to protect renewable resources.

Species that are low in abundance require special consideration for their protection and to maintain biodiversity. The EA has identified several species which are low in abundance and which might interact with the Project. In most cases, the likelihood of interaction, either directly or through habitat disruption, is low. This is attributable in large part to the terrestrial setting of the Project, *i.e.*, within a developed area. In the case of the marine ecosystem, the potential interaction is only with respect to an unplanned event, *i.e.*, a spill of Orimulsion® from tanker accident or during transfer. The likelihood of the occurrence of such events is low, and the consequences are less than presently exist with respect to Fuel Oil #6.

Clearly, care will be required to ensure the diligent application of effective mitigation measures where these address the protection of species/habitats at risk. Similarly, special diligence will be required to prevent the occurrence of spills or other incidents which could affect marine species, including the right whale and migratory bird species. NB Power has paid special attention to these concerns as part of the planning process, and will integrate appropriate environmental protection measures into all Project stages.

7.8 Climate Change, Including Effects Relevant To The Project

Scope of the Assessment

The CCGS is subject to the environment in which it is located. The CCGS may be affected by wind, snow, ice, salt spray and marine influences. These and other potential environmental effects have the potential to cause power outages, operational upsets and/or structural damage.

Boundaries

The CCGS life expectancy is approximately 25 years after refurbishment. Over this time frame it is possible that global climate change will have an effect on weather patterns in the Study Area. Studies to date vary widely with respect to climate change models so it is difficult to assess at this time any future changes in design requirements.

Baseline

The baseline climate conditions have been described in Section 5.

Likely Future Condition

According to the CCCMA, Atmospheric Environment Service of Environment Canada, the background climate change predictions in the Bay of Fundy include:

- Increase in Annual Mean Temperature (2040-2060 minus 1970-1990) estimated at approximately 1 to 2 degrees Celsius, with seasonal and regional differences.
- Increase in Annual Mean Precipitation (2041-2061 minus 1970-1990) estimated to be approximately 5 mm per day. There may be changes in the patterns and intensity of precipitation and seasonal and regional differences. The major threat from precipitation changes will be flooding and freezing rain, such as the ice storm, which affected Quebec and parts of Ontario and the Maritimes in January, 1998.
- Increase in Mean Sea Level in the range of 9 to 88 cm by 2100, with a good confidence of an average increase of 50 cm. This will exacerbate the frequency and severity of storm surge. Evidence of 9m waves has been recorded along the New Brunswick Coast in 2000 and 2001. The Sensitivity to Sea Level Rise for the New Brunswick coast of the Bay of Fundy has been rated Moderate to High by Natural Resources Canada.

The likelihood of halting or reversing these trends is considered to be low by the scientific community. Canada has not yet ratified the Kyoto Accord and the United States has signaled significant reluctance to do so. Various climate change action plans are in place in Canada and some provinces, but strong regulatory requirements are lacking.

Thus the major climate change effects potentially affecting the CCGS over the lifetime of the refurbishment project primarily include storm surge, freezing precipitation and sea level rise.

Effects Assessment

The CCGS site, irregular in shape with its southern boundary defined by the shoreline, measures approximately 2400 m from northeast to southwest by 1400 m from northwest to southeast. Virtually the entire site is steeply contoured from the shoreline inland, the only exceptions being those areas, which were developed to accommodate the initial construction of the facility. Typical grades range from 5 to 20% with the land rising from mean sea level to a maximum elevation of 100 m at the centre of the site.

The CCGS is located adjacent to the shoreline at elevation 20 m, with the main boiler house on the seaward side and the turbine hall on the landward side. The plant switchyard and terminal facilities, as well as the tank farm area, are located approximately 300 m from the station proper at elevation 100 m.

Increases in sea level and the frequency of storm events have the potential to affect delivery of fuel. However, given the storage that is available at Canaport and at the Station, this is considered to be a short term, and insignificant potential effect.

If precipitation does increase significantly, and leads to increased runoff requiring treatment at the waste water treatment plant, additional capacity can be incorporated at that time, and the effect is considered manageable.

Finally, the majority of existing and future structures have been/will be constructed of reinforced concrete, and have been/will be designed to required standards. The CCGS has already withstood the most significant New Brunswick coastal storm in recent history – the "Ground Hog Day Gale" in 1976.

7.9 Cumulative Effects

The cumulative effect of the Project has been considered for each VEC. It now remains necessary to present an overall consideration of cumulative effects in order to consider the impact, in combination, of all the Project induced effects.

The Effects Assessment has demonstrated that the Project will have a positive environmental effect on air quality, and a small but positive effect on community health and safety. This conclusion is not surprising, given that the reduction in air emissions is a prime objective of the Project. The analysis has also demonstrated that the Project will have a positive effect on the Marine Ecosystem by reducing the probability and consequences of an unplanned event (a spill). The effects assessment of the other VECs has shown that a negligible (not significant) effect is predicted with respect to Construction and Operations on the Terrestrial and Freshwater Ecosystem. Similarly the effects assessment with respect to economy and culture has shown a positive effect on economic indicators, mainly during Construction, but also during Operations. A negligible (not significant) effect on heritage resources is predicted for all Project phases.

In considering the various species and communities which are of special concern, including species at risk such as right whale, the predicted effects are either positive, or negligible (not significant).

Based on the residual effects predictions made in the effects assessments of each VEC, there are no cases where it is necessary to consider the cumulative effects of the Project in combination with other projects.

7.9.1 Climate Change and Global Warming

It may, nevertheless be useful to consider the general trends and initiatives which are relevant to this Project, *e.g.*, the Kyoto protocol. This issue has been addressed by NB Power both directly and through its membership in the Canadian Electricity Association.

7.9.2 Provincial, Regional and International Air Issue Initiatives

The following discusses the role of the Project in the following initiatives:

- NEG/ECP Acid Rain Action Plan and The Canada-Wide Acid Rain Strategy for Post-2000;
- The Canada-Wide Standard for PM and O_3;
- NEG/ECP Climate Change Action Plan and The Kyoto Agreement;
- Thermal Power Generation Emissions National Guidelines for New Stationary Sources under CEPA;
- CCME Canada Wide Standards for Mercury Emissions; and NEG/ECP Mercury Action Plan.

7.9.2.1 NEG/ECP Acid Rain Action Plan and The Canada-Wide Acid Rain Strategy for Post-2000

By reducing both annual emissions and emission rates of sulphur dioxide from CCGS, the Project plays a critical role in both NB Power's and the Province's efforts to reduce acid rain emissions consistent with the NEG/ECP Action plan, and the Canada-Wide Acid Rain Strategy. Specifically, the NBDELG initiated a two-phase reduction program to reduce the existing annual provincial SO_2 limit of 175,000 tonnes.

- Phase 1 - 30 % reduction by 2005
- Phase 2 - 50 % reduction by 2010

The NBDELG has informed NB Power that they expect NB Power's existing annual limit of 123,000 tonnes to be reduced by equal or greater percentages. The Department also required NB Power to file a sulphur dioxide emissions reduction plan outlining a proposed approach to achieving a target for CCGS not to exceed 40,000 tonnes of sulphur dioxide per year.

7.9.2.2 NEG/ECP Climate Change Action Plan and The Kyoto Agreement

Climate change is an important global issue and countries around the world are working together to meet this challenge. In December 1997, Canada and some 160 countries tentatively agreed to the Kyoto Protocol, in which industrialized countries undertook to reduce their collective emissions of greenhouse gases. Canada's target is to reduce its greenhouse emissions to 6 percent below 1990 levels between 2008 and 2012. In 2001 the Bush Administration withdrew the United States from the Protocol and Canada has yet to ratify it. Negotiations have been ongoing toward a softened agreement but nothing is yet final.

In August 2001, NEG/ECP developed a climate change action plan that addressed several action items including the reduction of greenhouse gases from the electricity sector. The key goal of this specific action item is to stabilize emissions at 1990 levels by 2010 and to target reductions of 10% for 2020. The targets are across the region in general and do not apply to individual provinces and states. Implementation of targets only in this region is expected to be controversial and difficult unless most other regions in North America adopt similar plans. In addition to reduction targets, the plan calls for the creation of a regional registry and the exploration of a trading mechanism. NB Power supports a trading mechanism but sees it as only a first step. Because climate change is a global issue the trading region must be much larger than the New England and Eastern Canada region.

In the absence of specific targets having been assigned to NB Power, a number of options have been identified that would allow NB Power as a whole to reduce greenhouse gas emissions. These options are discussed in detail in NB Power's Integrated Resource Plan (October, 2001) submitted as part of the Coleson Cove submission to the PUB. Coleson Cove's specific role in these options would depend on economic factors at the time targets were implemented, such that the least cost alternative is implemented.

7.9.2.3 Thermal Power Generation Emissions National Guidelines for New Stationary Sources under CEPA

Section 2(2) of the existing Thermal Power Generation Emissions National Guidelines for New Stationary Sources states:

"(2) The Guidelines are intended to apply to new units only. However, it is recognized that opportunities to reduce nitrogen oxides may arise during major alterations to an existing fossil fuel-fired steam generating unit. It is therefore recommended that an assessment of the feasibility of nitrogen oxides reduction measures be completed prior to commencing such alterations. This assessment should be undertaken by the owner of the unit in close consultation with the appropriate provincial regulatory authority, and improved nitrogen oxides control measures should be implemented wherever feasible." (May, 1993, "Thermal Power Generation Emissions - National Guidelines for New Stationary Sources")

The emission rates that would be applicable to a new source, according the to Guidelines, would be:

Nitrogen oxides	NOx	0.26 pounds per million Btu of energy input
Sulphur dioxide	SO_2	0.60 pounds per million Btu of energy input
Particulate	PM	0.10 pounds per million Btu of energy input

The following emission rates were chosen for the Project and they either meet or improve upon the Guidelines.

Nitrogen oxides	NOx	0.21 pounds per million Btu of energy input
Sulphur dioxide	SO_2	0.60 pounds per million Btu of energy input
Particulate	PM	0.01 pounds per million Btu of energy input

Therefore, NB Power considers that it has met the National Guidelines, including Section 2(2).

7.9.2.4 CCME Canada Wide Standards for Mercury Emissions; and NEG/ECP Mercury Action Plan

The federal government is developing national standards for new and existing coal plants. In addition, the NEG/ECP are developing an implementation plan for regional reductions in mercury emissions. Their current recommendations for annual mercury emissions from coal-fired generation call for:

- 20-50% reduction by January 2005 (base year 1995)
- 60-90% reduction by January 2010 (base year 1995)

NB Power mercury emissions are relatively small, being only 1.7% of those of the Northeast US plus Atlantic Canada and being about 1/3 of New Brunswick provincial emissions.

Emissions are expected to have been reduced by about 15% as Belledune has stopped using indigenous coal in 2002. After retirement of Grand Lake #8, system mercury emissions will have been reduced by about 85% of the 1995 base emissions. On this basis, Coleson Cove is not a key component of the initiatives to reduce mercury emissions.

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8.0 ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAMS

The Project will not cause significant adverse environmental effects, provided that recommendations, including implementation of mitigative measures identified in this EA report are implemented. Monitoring is recommended in the context of ensuring environmental protection function is maintained at a level equal to or better than pre-construction conditions. Recommended monitoring initiatives particularly focus on air quality monitoring, which is summarized in the following section.

8.1 Air Quality Monitoring

NB Power presently monitors the emissions of combustion gases and particulate matter to the atmosphere from the CCGS. These emissions are monitored for plant and combustion control, and to comply with conditions specified in their COA to operate.

The emissions of NOx, CO, and O_2 are monitored using a CEM system. In addition to these monitors, the emissions of SO_2 are monitored by a Software Continuous Emission Monitoring (SCEM) program. The SCEM uses plant operational data, including fuel flow, fuel analysis, unit operating load, and oxygen content of the flue gas to calculate the emission rate of SO_2 to the atmosphere. NB Power also operates a continuous opacity monitor downstream of the ESP (as stated in the COA).

The CEM program is supplemented by source emissions testing conducted in compliance with the conditions set forth in the facility's COA. Annual stack testing is conducted for particulate emissions as well as for NOx and SO_2.

NB Power proposes to install a new CEM system as part of the Project in accordance with the appropriate protocols.

8.1.1 Mitigation (Supplementary Control System)

NB Power currently operates a Supplementary Control System (SCS) on a continuing basis at the CCGS to immediately respond to potential increases in the downwind concentration of SO_2.

The SCS models the dispersion of SO_2 emissions on a daily basis to predict downwind ground-level concentrations. Based on the actual operating load at the time and a near term forecast of local weather conditions, predictions of the ground level concentration are made and the results are compared with stated objectives. Action is taken to reduce emissions, if needed. The CCGS is operated in this manner to ensure that actual emissions from the CCGS do not result in an exceedance of the ambient standards. NB Power proposes to continue the operation of this predictive system following the proposed refurbishment.

8.1.2 Ambient Air Quality Monitoring Systems

Currently, several ambient air quality monitoring stations are operated in the Saint John area by NBDELG and local industry and Environment Canada. Data from these stations was used to assess existing background and cumulative air quality parameters as described above.

The NBDELG and local industry operate a network of ambient monitors in the Saint John region. This network consists of approximately 12 separate locations, at which the concentrations of various pollutants are measured, including SO_2, NOx, total PM, PM_{10} and $PM_{2.5}$.

The Environmental Protection Service of Environment Canada also operates several ambient air quality monitors in the Saint John area as part of the National Air Pollution Surveillance (NAPS) network. These monitors measure a variety of pollutants, including SO_2, NOx, PM_{10} and $PM_{2.5}$. In some cases, monitoring stations are operated on a co-operative basis with NBDELG.

NB Power currently supports the operation of the provincial acid deposition monitoring network in all of New Brunswick, including southern New Brunswick and the Study Area of interest. Monitoring results from this network are reviewed and presented each year in the annual air quality monitoring report prepared by NBDELG.

There is an expected reduction in ground-level concentrations associated with emissions from the proposed post refurbishment operation of the CCGS. In addition, an extensive ambient monitoring network in the Saint John area currently exists and is expected to continue operation in the future. Therefore, NB Power's proposed plan is to continue the in-stack CEM and to analyse the data from the existing ambient air quality stations for the purposes of a continuing assessment of air quality issues in the region as they may pertain to the CCGS.

8.2 Environmental Compliance Monitoring (ECM)

The ECM will be performed by NB Power personnel. NB Power personnel will be familiar with the applicable regulations and will ensure that activities be planned and conducted with the knowledge and understanding of standard specifications. In the event of non-compliance, NB Power personnel overseeing the ECM will immediately report the activity to the appropriate personnel within NB Power, and implement measures to achieve compliance. Compliance monitoring will ensure that preventative and protective environmental measures are in place throughout construction and that appropriate regulations and NB Power's specifications are implemented during the Project development.

Project personnel will be fully qualified and will have applicable work experience. The Environmental Inspector will advise construction personnel on environmental matters, and oversee all environmental matters pertaining to construction. The Environmental Inspector will also report any activity that may cause adverse environmental effects, or any activities that do not meet environmental protection commitments.

During operations, general environmental conditions and new developments or activities on and near the CCGS and ancillary facilities will be monitored.

The current owner of the existing fuel pipeline has initiated an extensive program to monitor the integrity of this pipeline and, where required, the line is repaired. This owner will also operate and maintain the proposed new fuel pipeline between the Canaport tank farm and the Irving Oil Refinery.

8.3 Environmental Effects Monitoring (EEM)

The EEM is used to assess the accuracy of any predictions made in the EA concerning potential effects for new pipeline sections and the SWSDA. Following restoration of the RoW/site, the potential environmental effects of construction are monitored. A photographic and written record is made of conditions on and adjacent to the RoW and site at various times after construction. A visual examination of the environmental features will assist in the evaluation of recovery trends. Aerial observations and on-the-ground field surveys will be used. Where necessary, air, land, and water sampling programs will be developed to monitor site conditions. If problems are noted, site-specific rehabilitation programs will be established. These programs will be based on the results of the baseline sampling programs. The EEM will be site-specific and could include documentation of the following, as appropriate:

- groundwater quality in the vicinity of areas that may be potentially effected;
- the effect of vibrations associated with blasting activities on the aquatic environment (if fish are determined to be present) and surrounding areas;
- the quality of selected surface waters draining potentially disturbed areas;
- species at risk;
- wetlands (including alien invasive plant species); and
- aquatic habitat.

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APPENDIX A

Valued Environmental Components Table

Valued Environmental Components

V EC	Potential Impacts	Mitigation	Report Section
Air Quality	Air emissions due to the CCGS operation and traffic related to limestone/gypsum transportation and maintenance. Air emissions due to construction traffic.	Installation of additional emission reduction equipment at the CCGS including: I. Flue gas desulphuization system; II. Wet electrostatic precipitator; and III. A reburn combustion system.	Sections 4.3.2 and 7.2
Marine Ecosystem	Potential Spills of Orimulsion® in the Bay of Fundy may affect marine resources, species potentially at risk, marine mammals, shorebirds, fisheries and aquaculture, and areas for human recreation and/or historic significance (e.g. shipwrecks).	Orimulsion® vessel suppliers required to follow Bitor's corporate commitments related to fuel shipment Vessels meet or exceed international standards (i.e., MacKenzie Rating System) Only double-hulled vessels under 15 years old will be used for deliveries of Orimulsion® Officers selected for Orimulsion® tankers must speak both English and the mother tongue of the predominant crew nationality	Section 7.3
Terrestrial and Freshwater Ecosystem	Disturbance of fish or fish habitat, wetlands, species at risk, and terrestrial habitat including migratory birds as follows: i. Disturbance effects during construction for new pipeline sections; ii. Disturbance effects during operations and maintenance from new and existing pipelines (including accidental spills); iii. Surface water quality near the SWSDA during operations; iv. Groundwater quality adjacent to the SWSDA site during construction, operations, decommissioning;	Use Horizontal Directional Drilling (HDD) for wetland and watercourse crossings during pipeline construction or/and environmentally acceptable alternative. Withdraw hydrostatic test water from municipal sources and return to a municipal or industrial water treatment system. Design and implement a monitoring program to ensure sediment and erosion control measures are functioning properly. Provide education on environmental protection for workforce. Application of the generic New Brunswick Solid Waste Landfill Design criteria during construction of the proposed landfill. Conduct clearing activities outside of the nesting season (i.e., avoid May 1 to August 1) Avoid construction activities within riparian zones Develop site specific environmental protection plans where required	Section 7.4

Valued Environmental Components

V EC	Potential Impacts	Mitigation	Report Section
	v. Water quality and habitat disruption at water body crossings during construction of new pipeline sections, and during operation and maintenance of new and existing pipelines.	If wood turtles are encountered during clearing or construction, remove from the work area and place in the forest adjacent to a watercourse Continue monitoring and maintenance of existing pipeline	
Human Health and Safety	Community Health effects during operation and maintenance from airborne and deposited substances.	Reduce the air emission levels and maintain levels at or below existing Provincial guidelines.	Section 7.6
	Safety, congestion, noise effects on community from traffic during construction and operation and maintenance.	Restrict truck traffic during night time hours and reduce use of jake brakes. Install temporary signal lights at the intersection of the westbound Route 1 ramps with Ocean West Way/King William Road, at least during the peak six month period of construction.	Section 7.5.5 and 7.6.5
	Worker health and safety during construction and operations.	Enforce Provincial health and safety Acts and regulations, as well as NB Power's Health and Safety Policy.	Section 7.5.2
Economy and Culture	Economic and employment changes due to construction and operations.	None required.	Section 7.5.1
	Damage to archaeological resources during construction of the pipeline and the solid waste storage and disposal area.	Pre-construction field survey of areas with an elevated potential for archaeological resources. Develop protocol outlining required action in the event of archaeological\heritage resource discovery.	Section 7.5.4
Sustainability Assurance	Effects on ecosystem including rare and endangered species/communities by construction or operations.	Refer to measures listed above for Marine Ecosystem and Terrestrial and Freshwater Ecosystem.	Sections 7.3 and 7.4
	Cumulative effects including production of CO_2 and other greenhouse gases, acid rain, and harmful air emissions.	Implementation of Environmental Management System Program based on ISO 14000 standards and adherence to all Provincial and Federal Guidelines for air emissions.	Section 7.7 Section 7.9
Environment on the CCGS	Severe weather and shoreline erosion may affect facility lifespan or operation.	Existing and future facilities have been/will be designed to approved industry standards.	Section 7.8
	Short interruptions in sea-borne fuel delivery.	Provide fuel storage for short term operations	

APPENDIX B

Summary of Public Consultation Program

Coleson Cove Generating Station
Summary Results of Information Session Exit Questionnaires
May 30, 2001 to March 31, 2002

1. How did you hear about the Information Session?		
Newspaper advertisement	47	53.4%
NB Power employee	9	10.2%
Word-of-mouth	7	8.0%
Radio	3	3.4%
Television	1	1.1%
Other	20	22.7%
Not Answered	1	1.1%
	88	100.0%

2. Prior to today, how knowledgeable would you say you were about the future of the Coleson Cove Generating Station?		
Very knowledgeable	5	5.7%
Knowledgeable	25	28.4%
Somewhat knowledgeable	42	47.7%
Not knowledgeable at all	15	17.0%
Not Answered	1	1.1%
	88	100.0%

3. Following the Information Session, how knowledgeable would you say you are about the future of the Coleson Cove Generating Station?		
Very knowledgeable	24	27.3%
Knowledgeable	45	51.1%
Somewhat knowledgeable	17	19.3%
Not knowledgeable at all	1	1.1%
Not Answered	1	1.1%
	88	100.0%

4. In terms of the content of the information you received today, would you say that the displays were:		
Too technical	1	1.1%
Just right	79	89.8%
Not technical enough	7	8.0%
Not Answered	1	1.1%
	88	100.0%

Coleson Cove Generating Station
Summary Results of Information Session Exit Questionnaires
May 30, 2001 to March 31, 2002

5. Did you attend one of the presentations given today by NB Power?		
Yes	67	76.1%
No	21	23.9%
	88	100.0%

6. In terms of the content of the information you received today, would you say that the presentation by NB Power was:		
Too technical	3	3.4%
Just right	72	81.8%
Not technical enough	6	6.8%
Not answered	7	8.0%
	88	100.0%

7a. Were all of the areas that are of interest to you about the future of the Coleson Cove Generating Station covered today?		
Yes	56	63.6%
No	30	34.1%
Not answered	2	2.3%
	88	100.0%

7b. If not, what areas would you have like to see included?	
Exporting of power by coleson cove	1
More information on fuel	1
More guarantees of better performance	1
Details on timeframe	1
Reduction of emmissions over the next 5 years	1
More information about amonia and gypsum	1
Detailed timetables of the actual report	1
Involvement of First Nations	1
Wind Turbine Information	1
Archeology protocol	1
Information not known by NB Power yet	1
Follow ups	1
More information about SCR's	1
Upgrade to control system	1
Tender process	2
More research on Environmental and health impacts	1
Environmental issues	3
	20

Coleson Cove Generating Station
Summary Results of Information Session Exit Questionnaires
May 30, 2001 to March 31, 2002

8. How often have you visited the NB Power Web site?		
Never	39	44.3%
Never before today	3	3.4%
Occasionally	31	35.2%
On a regular basis	9	10.2%
Not answered	6	6.8%
	88	100.0%

9. What was the most useful part of the Information Session?		
Presentation and Q&A	4	6.8%
Environmental Issues	8	13.6%
Explanation about Fuel	2	3.4%
Opportunity to talk to staff	8	13.6%
Opportunity to gather information	6	10.2%
Information about Orimulsion	13	22.0%
Information Packages	2	3.4%
Presentations	2	3.4%
Budget is self funding	1	1.7%
Employment	1	1.7%
Time lines	3	5.1%
Pipeline Route	1	1.7%
Location	1	1.7%
Entire Session	1	1.7%
Economic alternative comparisons	1	
Shore Storage	1	
Start date	1	
Construction and equipment information	1	
Reasons for modification and refurbishment	1	1.7%
Public Feedback	1	1.7%
	59	93.2%

10. How long have you lived in the area?		
Less than one year	4	4.5%
1 - 5 years	5	5.7%
6 - 10 years	3	3.4%
11 - 15 years	7	8.0%
16+ years	59	67.0%
Not answered	10	11.4%
	88	100.0%

Coleson Cove Generating Station
Summary Results of Information Session Exit Questionnaires
May 30, 2001 to March 31, 2002

11. To which age group do you belong?		
0 - 20 years	1	1.1%
21 - 40 years	23	26.1%
41 - 60 years	46	52.3%
61+ years	12	13.6%
Not answered	6	6.8%
	88	100.0%

12a. Were all the questions you had today answered to your satisfaction?		
Yes	68	77.3%
No	14	15.9%
Not answered	6	6.8%
	88	100.0%

APPENDIX C

Contact List

Contact List

Contact Name	Organization	Reason Contacted
Beattie, B.	Environment Canada	Climate and weather data
Boyne, Andrew	Canadian Wildlife Service	Bird species of concern
Brilliant, Sean	NB Department of Natural Resources and Energy	Stream enhancement work
Burtt, Jonathon	NB Department of Environment and Local Government	Designated watersheds
Byers, Todd	NB Department of Natural Resources and Energy	Eastern Habitat Joint Venture Sites
Campbell, Craig	City of Saint John	Heritage issues and concerns
Carson, Steve	Enterprise Saint John	Major Employers in Saint John
Chardine, John	Canadian Wildlife Service	Seabird Species of Concern
Clayden, Stephen	NB Museum	Rare plants
Cole, Darlene	NB Department of Natural Resources and Energy	Crown leases, Sugar Bush
Craig, N.	NB Department of Environment and Local Government	ESAs
Ferguson, Albert	Archaeological Services Unit, Heritage Branch, Culture and Sport Secretariat	Archaeological sites
Gautreau, Rachel	Canadian Wildlife Service	Species of concern
Gerriets, Stefen	Atlantic Canada Conservation Data Centre	Species of concern
Hamilton, Shawn	NB Department of Environment and Local Government	Protected watersheds and well fields
Harvey, Joe	Ducks Unlimited	Ducks Unlimited impoundments
Herman, T.	Acadia University	Species at Risk
Holt, Captain William	Corbett and Holt	Marine Transportation
Hoyt, Jeff	NB Department of Natural Resources and Energy	Bald eagles
Hughes, Gary	NB Museum	Heritage resource issues and concerns
Hughes, Rob	NB Department of Environment and Local Government	Air quality monitoring results
Hunt, Roger	Fundy North Fishermens Association	Commercial Fisheries
James, Mike	Dalhousie University	Leatherback Turtles
Keating, Brian	Department of Fisheries and Oceans Canada	Commercial and recreational fisheries, stream enhancement activities
Les, Fyffe	NB Department of Natural Resources and Energy, Minerals Branch	Seismic activity
Libby, Cade	NB Department of Natural Resources and Energy, Fish and Wildlife	Lynx sightings
MacLeod, Malcolm	NB Department of Natural Resources and Energy, Minerals Branch	Acid generating bedrock
Marshall. Martin	NB Department of Natural Resources and Energy, Crown Lands	Ecological Reserves

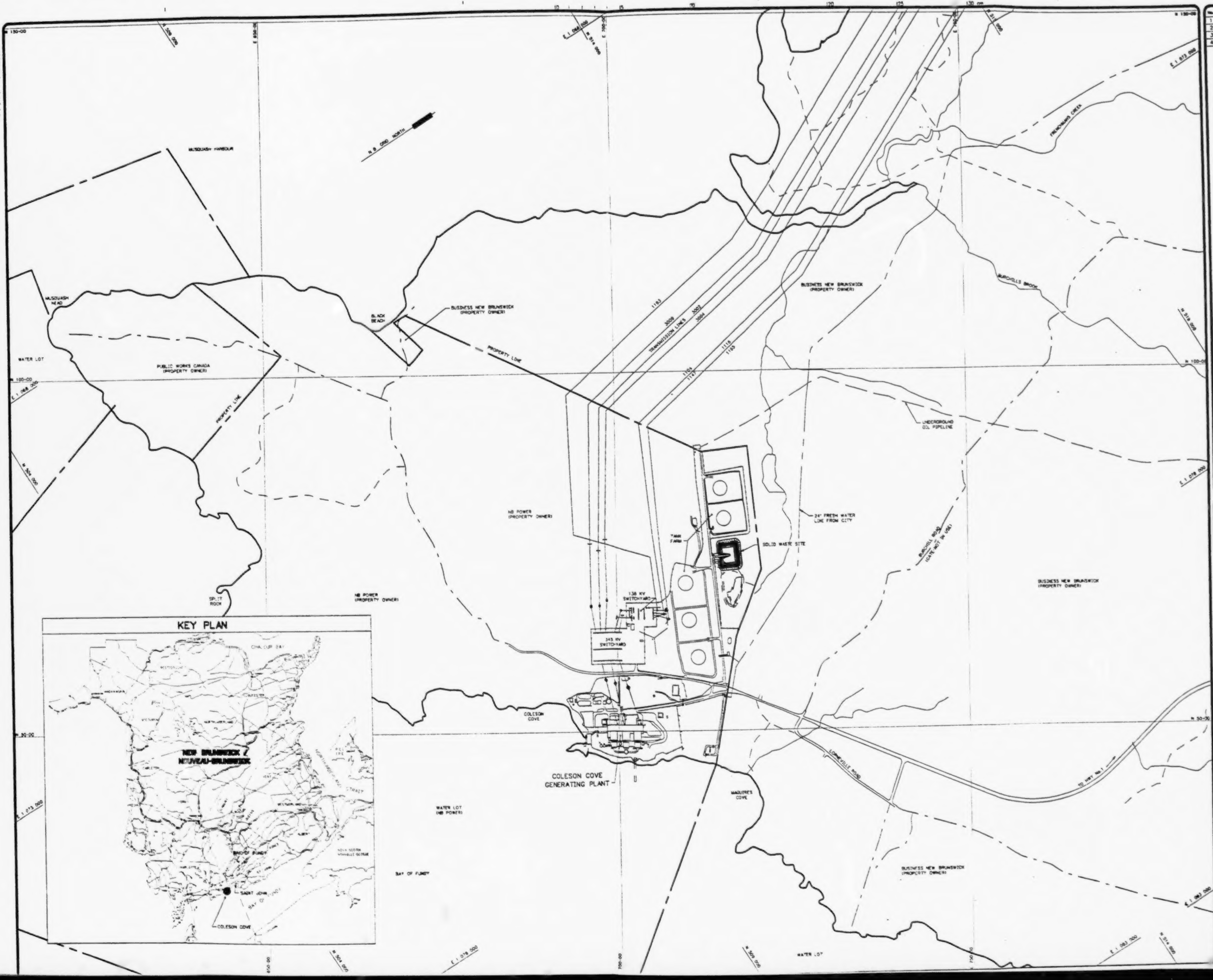
Contact List

Contact Name	Organization	Reason Contacted
McAlpine, Don	New Brunswick Museum	Rare mammals and Wood Turtles
Melvin, Gary	Fisheries and Oceans Canada	Herring Fishery
Morrison, Bernie	City of Saint John, Recreation and Parks	Recreation areas and parks
O'Donnell, Mitchell	NB Department of Natural Resources and Energy, Minerals Branch	Pit and Quarry locations
Paul-Elias, Michelle	NB Department of Environment and Local Government	Wellfield Protection Study in Saint John
Pelkey, H	NB Department of Environment and Local Government	Watercourse alterations
Phillips, Richard	Heritage Branch, Culture and Sport Secretariat	Heritage structures and related issues
Robichaud, M.	Enterprise Saint John	Major employers in Saint John
Robinson, S.	Fisheries and Oceans Canada	Sea Urchin Fishery
Sabine, Dwayne	New Brunswick Department of Natural Resources and Energy	Species at risk information
Saunders, G.	University of New Brunswick	Marine plant species at risk
Savoie, Melanie	NB Department of Environment and Local Government	Environmentally Significant Areas (ESAs)
Seymour, Pam	NB Department of Natural Resources and Energy	Fisheries information
Sharma, Mana	Nature Trust of New Brunswick Inc.	Nature preserves and ESAs
Sharpe, Glyn	Fisheries and Oceans Canada	Rockweed
Shaw, Ron	NB Department of Natural Resources and Energy	Mining Leases, Mineral Claims
Simpson, Jamie	Nature Trust of New Brunswick, Inc.	Nature Preserves and ESAs
St. Peter, Clint	NB Department of Natural Resources and Energy	Sinkhole and subsidence
Thompson, G.	Fisheries and Oceans Canada	Shellfish Fisheries
Toner, Maureen	NB Department of Natural Resources and Energy	Species information
Turner, Peter	Harbour Master	Pers. comm., 2002
Woods, Don	NB Department of Environment and Local Government	Landfill sites

APPENDIX D

Coleson Cove Design Drawings

C:\dgn\0052392\imperial\2-1.dgn


N 130-00
MUSQUASH HARBOUR
N.B. GRID NORTH
MUSQUASH HEAD
WATER LOT
PUBLIC WORKS CANADA (PROPERTY OWNER)
PROPERTY LINE
N 100-00
BLACK BEACH
BUSINESS NEW BRUNSWICK (PROPERTY OWNER)
PROPERTY LINE
TRANSMISSION LINES
1163
3008
3002
3004
1116
1165
1104
1147
BUSINESS NEW BRUNSWICK (PROPERTY OWNER)
FRENCHMANS CREEK
BURCHILLS BROOK
UNDERGROUND OIL PIPELINE
NB POWER (PROPERTY OWNER)
TANK FARM
SOLID WASTE SITE
24" FRESH WATER LINE FROM CITY
BURCHILL ROAD (GATE NOT IN USE)
BUSINESS NEW BRUNSWICK (PROPERTY OWNER)
SPLIT ROCK
NB POWER (PROPERTY OWNER)
138 KV SWITCHYARD
345 KV SWITCHYARD
COLESON COVE
COLESON COVE GENERATING PLANT
MAGUIRES COVE
LORNEVILLE ROAD
TO HWY. NO.1
N 50-00
WATER LOT (NB POWER)
BAY OF FUNDY
BUSINESS NEW BRUNSWICK (PROPERTY OWNER)
WATER LOT
KEY PLAN
CHALEUR BAY
NEW BRUNSWICK / NOUVEAU-BRUNSWICK
STRAIT
BAY OF FUNDY
NOVA SCOTIA NOUVELLE-ÉCOSSE
SAINT JOHN
BAY OF FUNDY
COLESON COVE
E 1 073 000
E 1 078 000
E 1 083 000
N 504 000
N 509 000
N 514 000
850-00
700-00
750-00

No.	Issued	Date
1	DESIGN REVIEW	01.07.18
2	ESTIMATE	01.07.27
3	EIA APPLICATION	02.FEB.27
4	EIA APPLICATION	02.MAY.14

NOTES:

1. PARTIAL GRID SHOWN IS IMPERIAL NB GRID.
2. FULL GRID SHOWN IS PLANT GRID.
3. THE ANGLE BETWEEN THE GRIDS IS 58°. THE COORDINATES OF THEIR COMMON POINT ARE: NB GRID E 1076 528.83, N 509 131.14 PLANT E 700-00, N 50-00

No.	Revision	Ckd. By	Date

Subconsultant

Project No.

PRELIMINARY

Const. North ↑

Drawn By: NWR/RWS

Dwg. Standards Ckd. By:

Designed By: /MAS

Date Printed

Design Ckd. By: /DPS

Date Last Modified

Last Modified By:

ADI Limited
Fredericton NB Canada
Engineering, Consulting, Procurement and Project Management

Project Title

COLESON COVE
REFURBISHMENT

Dwg. Title

EXISTING
SITE PLAN

Project No. 52-392.1

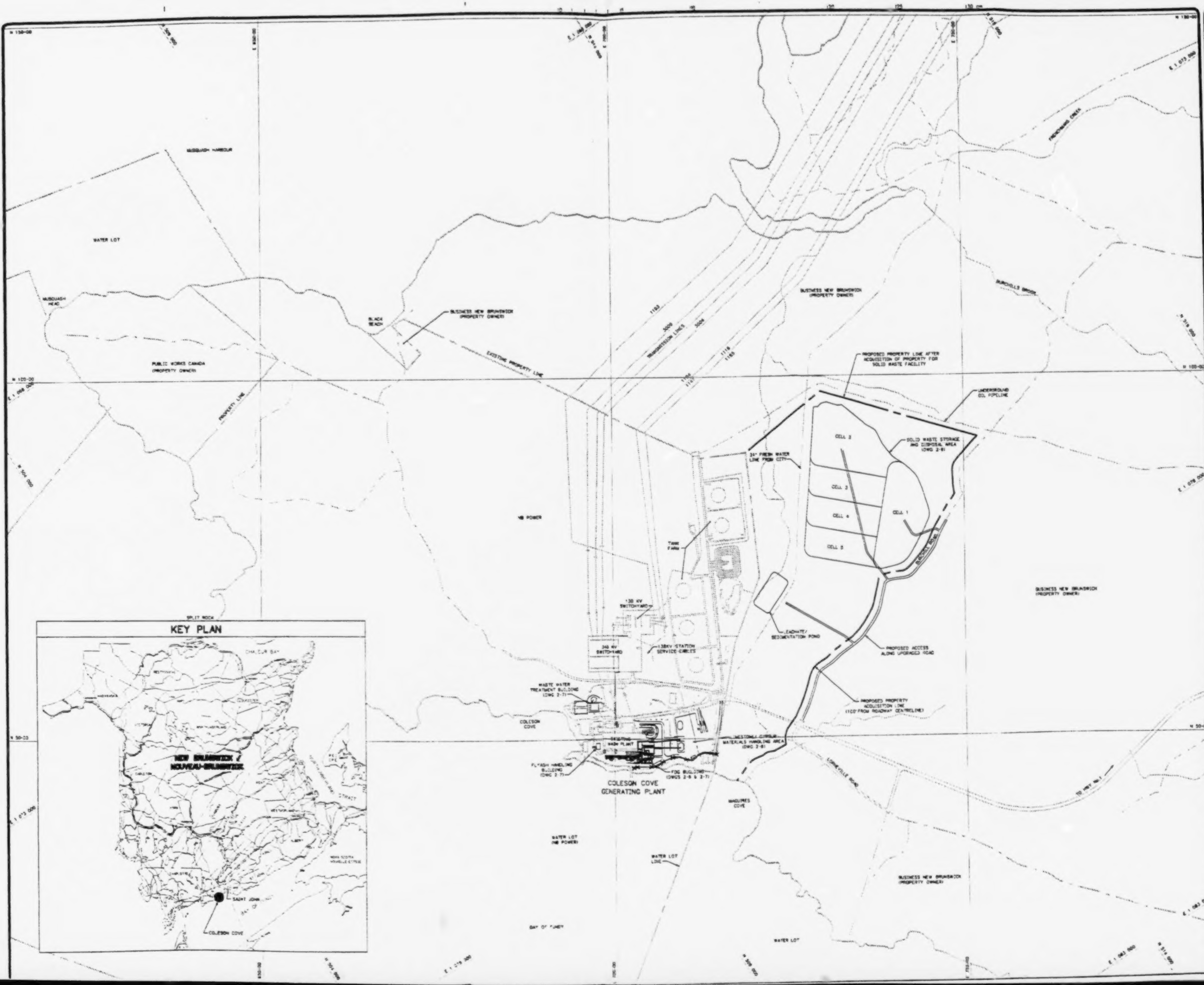
Dwg. No. 2-1

Rev. No. 0

Scale 1" = 500'

This drawing is not to be scaled

Offices located in:
Charlottetown, Moncton, Saint John, Truro, Halifax, Sydney [illegible]


MUSQUASH HARBOUR
WATER LOT
MUSQUASH HEAD
BLACK BEACH
BUSINESS NEW BRUNSWICK (PROPERTY OWNER)
PUBLIC WORKS CANADA (PROPERTY OWNER)
PROPERTY LINE
EXISTING PROPERTY LINE
TRANSMISSION LINES
NB POWER
PROPOSED PROPERTY LINE AFTER ACQUISITION OF PROPERTY FOR SOLID WASTE FACILITY
UNDERGROUND OIL PIPELINE
SOLID WASTE STORAGE AND DISPOSAL AREA (DWG 2-8)
36" FRESH WATER LINE FROM CITY
CELL 2
CELL 3
CELL 4
CELL 5
CELL 1
BURCHILL ROAD
BURCHILLS BROOK
TANK FARM
138 KV SWITCHYARD
345 KV SWITCHYARD
138KV STATION SERVICE CABLES
LEACHATE/ SEDIMENTATION POND
PROPOSED ACCESS ALONG UPGRADED ROAD
PROPOSED PROPERTY ACQUISITION LINE (100' FROM ROADWAY CENTRELINE)
WASTE WATER TREATMENT BUILDING (DWG 2-7)
COLESON COVE
EXISTING WASH PLANT
LIMESTONE/ GYPSUM MATERIALS HANDLING AREA (DWG 2-8)
FLYASH HANDLING BUILDING (DWG 2-7)
FGD BUILDING (DWGS 2-6 & 2-7)
COLESON COVE GENERATING PLANT
MAGUIRES COVE
LORNEVILLE ROAD
TO HWY No.1
WATER LOT (NB POWER)
WATER LOT LINE
WATER LOT
BAY OF FUNDY
SPLIT ROCK
BUSINESS NEW BRUNSWICK (PROPERTY OWNER)
N 150-00
N 100-00
N 50-00
KEY PLAN
CHALEUR BAY
NEW BRUNSWICK / NOUVEAU-BRUNSWICK
NOVA SCOTIA NOUVELLE-ECOSSE
SAINT JOHN
COLESON COVE

No.	Issue	Date
1	DESIGN REVIEW	01.07.18
2	EIA REGISTRATION	01.07.23
3	ESTIMATE	01.07.27
4	EIA APPLICATION	02.FEB.27
5	EIA APPLICATION	02.MAY.14

NOTES:

1. PARTIAL GRID SHOWN IS IMPERIAL NB GRID.
2. FULL GRID SHOWN IS PLANT GRID.
3. THE ANGLE BETWEEN THE GRIDS IS 38°. THE COORDINATES OF THEIR COMMON POINT ARE: NB GRID E 1076 536.83, N 905 131.14 PLANT E 700+00, N 50-00

No.	Revision	Chk. By	Date

Subconsultant

Project No.

PRELIMINARY

Const. North

Drawn By: NWR/RWS

Dwg. Standards Chk. By:

Designed By: /MAS

Date Printed

Design Chk. By: /DPS

Date Last Modified

Last Modified By:

ADI Limited
Fredericton NB Canada
Engineering, Consulting, Procurement and Project Management

Project Title

COLESON COVE REFURBISHMENT

Dwg. Title

SITE PLAN 1"=500' SCALE

Project No. 52-392.1

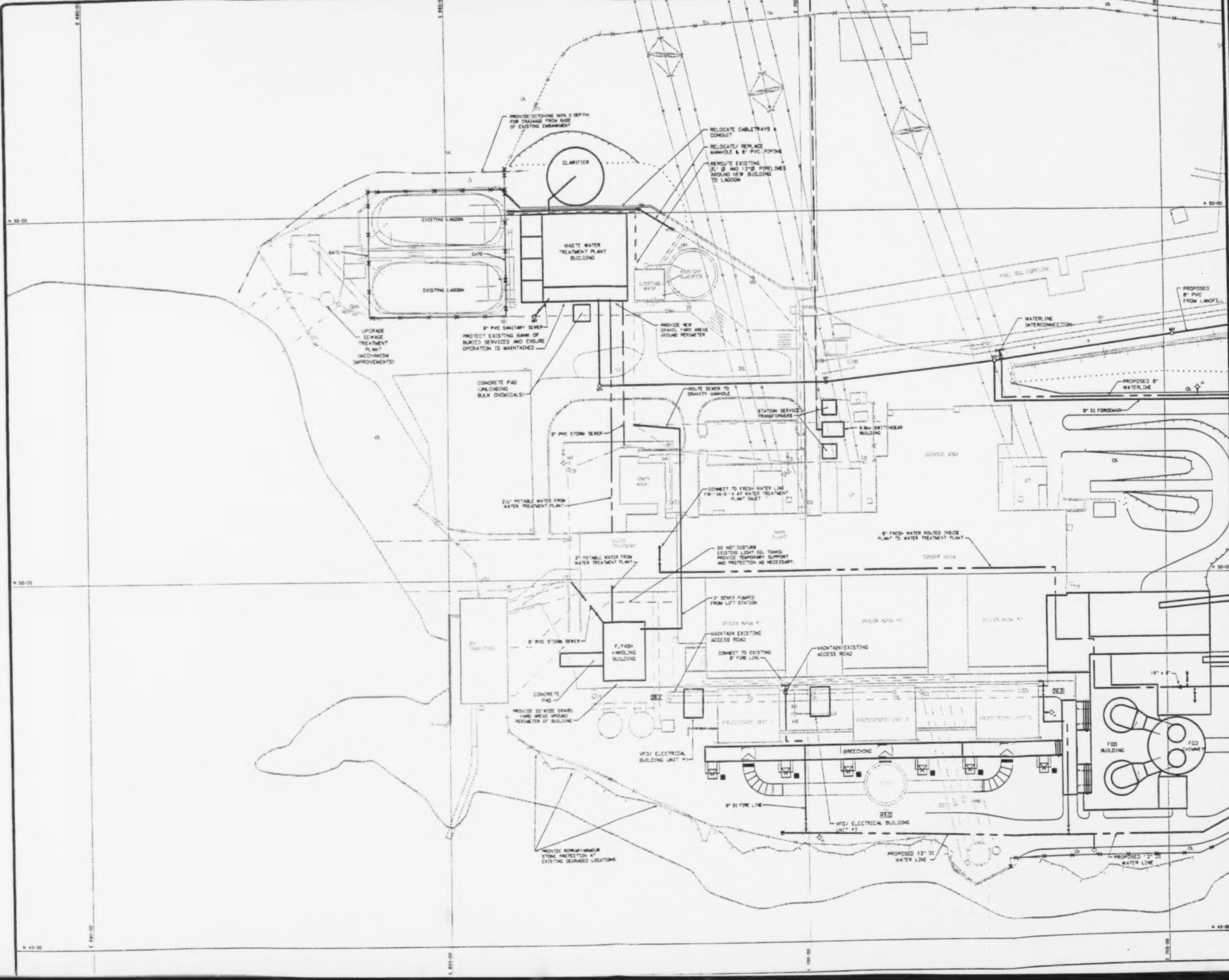
Dwg. No. 2-4

Rev. No. 0

Scale 1" = 500'

This drawing is not to be scaled

Offices across at
Charlottetown, Moncton, Saint John, Truro, Halifax, Sydney



CLARIFIER
EXISTING LAGOON
EXISTING LAGOON
GATE
GATE
WASTE WATER TREATMENT PLANT BUILDING
PROVIDE/DITCHING WITH 3 DEPTH FOR DRAINAGE FROM BASE OF EXISTING EMBANKMENT
RELOCATE CABLETRAYS & CONDUIT
RELOCATE/ REPLACE MANHOLE & 8" PVC PIPING
REROUTE EXISTING 8" Ø AND 12"Ø PIPELINES AROUND NEW BUILDING TO LAGOON
UPGRADE SEWAGE TREATMENT PLANT (MECHANISM IMPROVEMENTS)
8" PVC SANITARY SEWER
PROTECT EXISTING BANK OF BURIED SERVICES AND ENSURE OPERATION IS MAINTAINED
PROVIDE NEW GRAVEL YARD AREAS AROUND PERIMETER
CONCRETE PAD (UNLOADING BULK CHEMICALS)
FUEL OIL PIPELINE
PROPOSED 8" PVC FROM LANDFILL
WATERLINE INTERCONNECTION
PROPOSED 8" WATERLINE
8" DI FORCEMAIN
ROUTE SEWER TO GRAVITY MANHOLE
STATION SERVICE TRANSFORMERS
6.9kv SWITCHGEAR BUILDING
8" PVC STORM SEWER
2½" POTABLE WATER FROM WATER TREATMENT PLANT
CONNECT TO FRESH WATER LINE FW-16-8-A AT WATER TREATMENT PLANT INLET
8" FRESH WATER ROUTED INSIDE PLANT TO WATER TREATMENT PLANT
DO NOT DISTURB EXISTING LIGHT OIL TANKS; PROVIDE TEMPORARY SUPPORT AND PROTECTION AS NECESSARY.
2" POTABLE WATER FROM WATER TREATMENT PLANT
2" SEWER PUMPED FROM LIFT STATION
MAINTAIN EXISTING ACCESS ROAD
8" PVC STORM SEWER
FLYASH HANDLING BUILDING
CONNECT TO EXISTING 8" FIRE LINE
MAINTAIN EXISTING ACCESS ROAD
CONCRETE PAD
PROVIDE 20' WIDE GRAVEL YARD AREAS AROUND PERIMETER OF BUILDING
VFD/ ELECTRICAL BUILDING UNIT #1
BREECHING
8" DI FIRE LINE
VFD/ ELECTRICAL BUILDING UNIT #2
FGD BUILDING
FGD CHIMNEY
PROVIDE RIPRAP/ARMOUR STONE PROTECTION AT EXISTING DEGRADED LOCATIONS
PROPOSED 12" DI WATER LINE
PROPOSED 12" DI WATER LINE
N 55-00
N 50-00
N 45-00
CL

No.	Issue	Date
1	DESIGN REVIEW	01.07.16
2	ESTIMATE	01.07.27
3	ESTIMATE REVIEW	01.10.09
4	EIA APPLICATION	02.FEB.27
5	DRAWING UPDATE	02.APR.04
6	EIA APPLICATION	02.MAY.14

LEGEND

EXISTING — PROPOSED

BOTTOM OF BANK
CATCH BASIN
DITCH
FENCE
FRESHWATER/FIREWATER
GATE VALVE/CHAMBER
GRADE
HYDRANT
LIGHT STANDARD
MANHOLE
PROPERTY LINE
SANITARY/FORCEMAIN
STORM SEWER
TOP OF BANK
TRANSMISSION LINE
U/G POWERLINE

NOTES:

1. RESTORE EXISTING SURFACES DAMAGED BY CONSTRUCTION ACTIVITIES.
2. REFER TO NOTES 1 AND 4 ON DRAWING 2-6.
3. PARTIAL GRID SHOWN IS IMPERIAL NB GRID.
4. FULL GRID SHOWN IS PLANT GRID.
5. THE ANGLE BETWEEN THE GRIDS IS 38°. THE COORDINATES OF THEIR COMMON POINT ARE: NB GRID E 1076 526.83, N 908 131.14 PLANT E 700-00, N 50-00

No.	Revision	Chk. By	Date

Subconsultant

Project No.

PRELIMINARY

Const. North

Drawn By: RWS
Dsg. Standards Chk. By:
Designed By: /MAS
Design Chk. By: /DPS
Date Printed
Date Last Modified
Last Modified By

ADI Limited
Fredericton, NB, Canada
Engineering, Consulting, Procurement and Project Management

Project Title

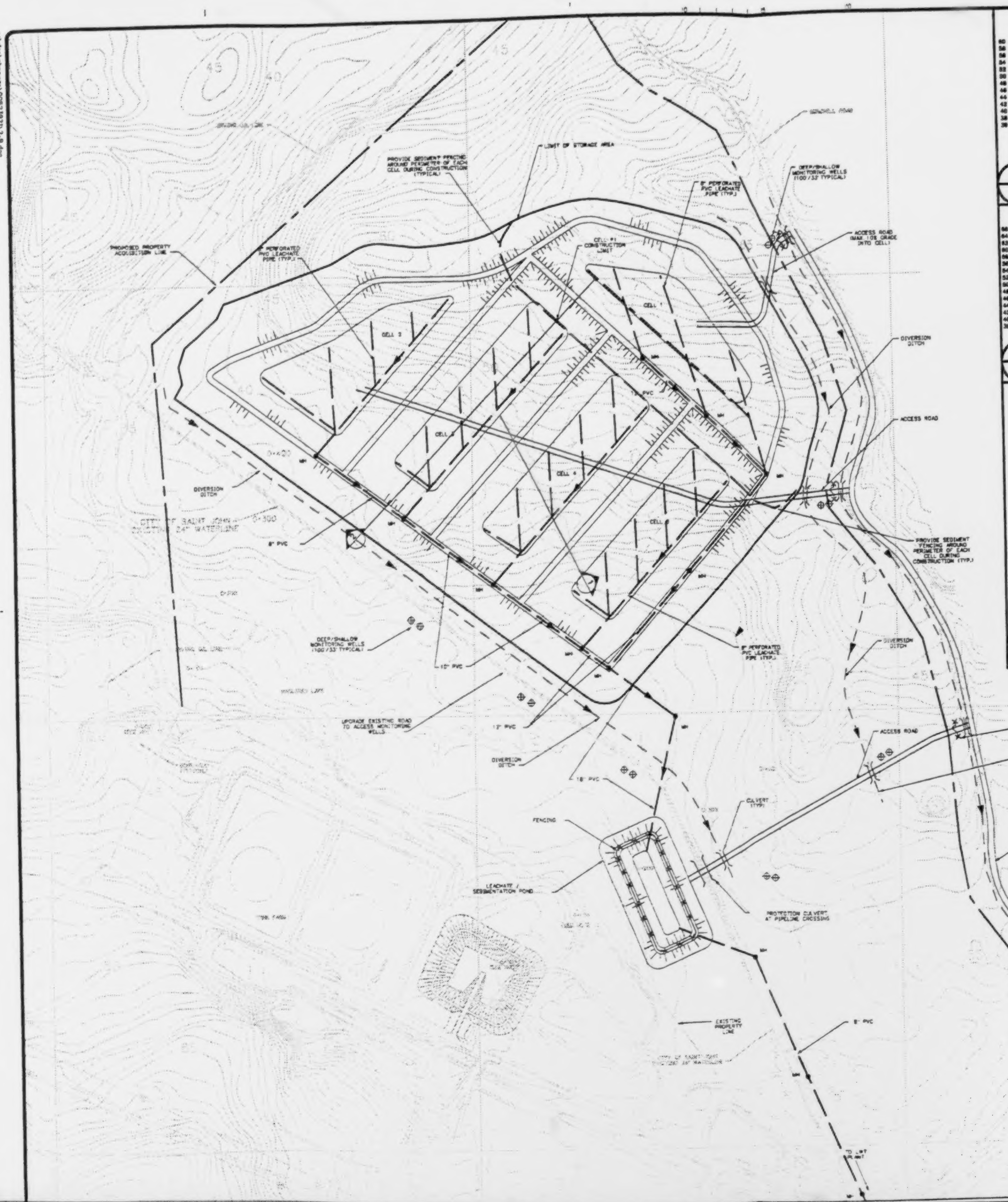
COLESON COVE REFURBISHMENT

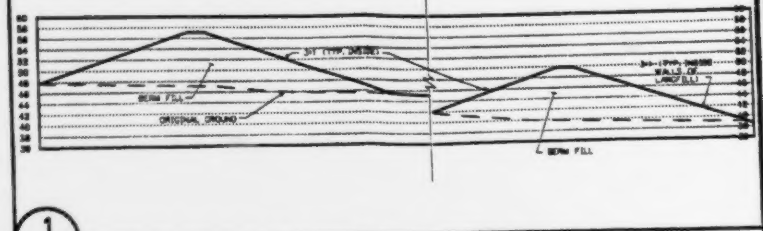
Dwg. Title

WWTP AREA SITE LAYOUT & BURIED SERVICES

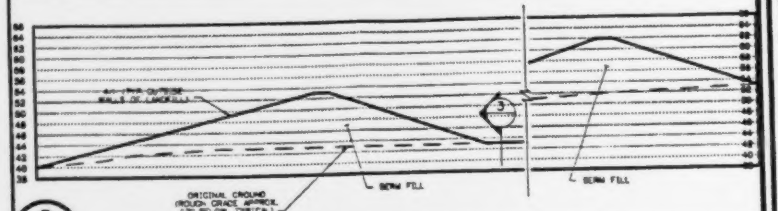
Project No. 52-392.1
Dwg. No. 2-7
Rev. No. 0
Scale 1" = 50-0'
This drawing is not to be scaled

Offices across in:
Charlottetown, Moncton, Saint John, Truro, Halifax, Sydney

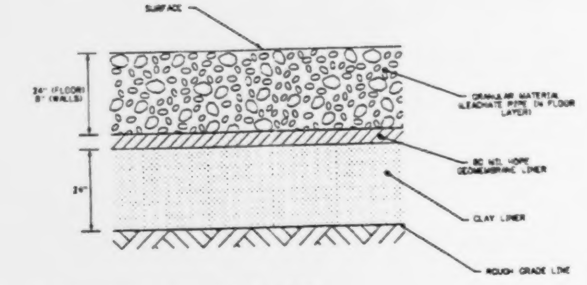

PROPOSED PROPERTY ACQUISITION LINE
8" PERFORATED PVC LEACHATE PIPE (TYP.)
PROVIDE SEDIMENT FENCING AROUND PERIMETER OF EACH CELL DURING CONSTRUCTION (TYPICAL)
LIMIT OF STORAGE AREA
8" PERFORATED PVC LEACHATE PIPE (TYP.)
CELL #1 CONSTRUCTION LIMIT
BIRCHILL ROAD
DEEP/SHALLOW MONITORING WELLS (100 / 33' TYPICAL)
ACCESS ROAD (MAX. 10% GRADE INTO CELL)
CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
12" PVC
DIVERSION DITCH
ACCESS ROAD
DIVERSION DITCH
CITY OF SAINT JOHN EXISTING 24" WATERLINE
8" PVC
PROVIDE SEDIMENT FENCING AROUND PERIMETER OF EACH CELL DURING CONSTRUCTION (TYP.)
DEEP/SHALLOW MONITORING WELLS (100 / 33' TYPICAL)
10" PVC
8" PERFORATED PVC LEACHATE PIPE (TYP.)
DIVERSION DITCH
UPGRADE EXISTING ROAD TO ACCESS MONITORING WELLS
12" PVC
DIVERSION DITCH
18" PVC
ACCESS ROAD
LOCKING SWING GATE (TYPICAL)
TO NATURAL DRAINAGE (TYPICAL)
FENCING
CULVERT (TYP)
BIRCHILL ROAD (REPAIR & REPAVE SURFACE)
LEACHATE / SEDIMENTATION POND
PROTECTION CULVERT AT PIPELINE CROSSING
EXISTING SHOULDERS AND DITCH (REMOVE DEBRIS & VEGETATION)
REPLACE EXISTING LOCKING SWING GATE
EXISTING PROPERTY LINE
8" PVC
TO HWY NO 1
TO LWT PLANT
45
40
45


3:1 (TYP. INSIDE)
3:1 (TYP. INSIDE WALLS OF LANDFILL)
BERM FILL
ORIGINAL GROUND
BERM FILL

1 TYPICAL SECTION - INTERIOR BERMS 1:500


4:1 (TYP. OUTSIDE WALLS OF LANDFILL)
ORIGINAL GROUND (ROUGH GRADE APPROX. 12" BELOW TYPICAL)
BERM FILL
BERM FILL

2 TYPICAL SECTION - EXTERIOR BERMS 1:500


SURFACE
24" (FLOOR)
8" (WALLS)
24"
GRANULAR MATERIAL (LEACHATE PIPE IN FLOOR LAYER)
60 MIL HDPE GEOMEMBRANE LINER
CLAY LINER
ROUGH GRADE LINE

NOTES:

1. AFTER EACH CELL IS COMPLETELY FILLED WITH SOLID WASTE, CELL CAP CONSTRUCTION SHALL CONSIST OF 18" CLAY LINER, 60 MIL HDPE GEOMEMBRANE, 4" GRANULAR MATERIAL AND 6" TOPSOIL AND SEEDING.
2. CELL EXTERIOR BERM SURFACES SHALL BE 6" TOPSOIL AND SEEDING.

3 TYPICAL SECTION - CELL INTERIOR SURFACES N.T.S.

No.	Issue	Date
1	DESIGN REVIEW	01.07.16
2	ESTIMATE	01.07.27
3	EIA APPLICATION	02.FEB.27
4	EIA APPLICATION	02.MAY.14

25 YEAR LANDFILL DEVELOPMENT:

CELL 1 (YEARS 1-5)
425,000 TONS

100,000 t GYPSUM COMMISSION
282,000 t GYPSUM, 10%
82,500 t SLUDGE

CELL 2 (YEARS 6-10)
325,000 TONS

282,000 t GYPSUM, 10%
82,500 t SLUDGE

CELLS 3 TO 5 (YEARS 11-25)
SIMILAR TO CELL 2

NOTES:

1. BOREHOLES ARE DESIGNATED FROM 1985 INFORMATION AND SHOWN IN APPROXIMATE LOCATIONS AT FORMER PROPOSED MIDDLE OR SOUTH DYKES.
2. CELL #1 CONSTRUCTION FOR PLANT STARTUP. FURTHER CELL CONSTRUCTION SCHEDULE SHALL BE DETERMINED DURING YEARS 1-5 OPERATION.
3. CELL #1 STORAGE AREA (ONLY) IS TO BE CLEARED, DURING CELL 1 CONSTRUCTION.
4. GRID SHOWN IS NB METRIC GRID.
5. FOLLOWING THE CLEARING OPERATION PROVIDE GRUBBING AND STOCKPILE TOPSOIL IN APPROVED LOCATION FOR RE-USE ON BERMS.

No.	Revision	Chk. By:	Date

Subconsultant

Project No.

PRELIMINARY

Const. North

Drawn By: SLS
Dwg. Standards Chk. By:
Designed By: /SLS
Date Printed
Dwg. Design Chk. By: /MAS

ADI Limited
Fredericton, NB, Canada
Engineering, Consulting, Procurement and Project Management

Project Title
COLESON COVE
REFURBISHMENT

Dwg. Title
SOLID WASTE
STORAGE & DISPOSAL
SITE PLAN &
SECTIONS

Project No. 52-392-1
Dwg. No. 2-9
Rev. No. C
Scale 1:2000
This drawing is not to be scaled

Offices located at:
Charlottetown, Moncton, Saint John, Truro, Halifax, Sydney

APPENDIX E

Background Information on the Development of a CO_2 Mitigation Plan for NB Power

This Appendix provides background information related to the development of a CO_2 mitigation plan for NB Power. It includes exerpts of testimony and evidence filed with the Board of Commissioners of Public Utilities as part of both Coleson Cove Refurbishment and Point Lepreau Refurbishment Hearings.

			Total CO_2 Emissions	
			2010 (Mte)	2020 (Mte)
Business as Usual Operation			9.8	10.2
CO_2 Mitigation Options	Generation Replacement (GWh)	CO_2 Emissions Reduction (Mte)		
• Point Lepreau Refurbishment	0	(0)		
• Reduce Low Margin Exports	1500	(1.1)		
• Redispatch Orimulsion® ahead of Coal	1500	(0.4)		
• DSM/Fuel Switching	700	(0.5)		
• Renewables	500	(0.3)		
• Sponsorship offset Projects (i.e. methane capture from landfill)	0	(0.5)		
Total	4200	2.8		
Total CO_2 emissions following Mitigation Options			6.6	7.4

Additional reduction options if emissions trading values warrant them	Generation Replacement (GWh)	CO_2 Emissions Reduction (Mte)		
• High Margin Exports	2000	(1.5)		
• Additional DSM/Fuel Switching	700	(0.5)		
• Additional Renewables	500	(0.3)		
• Additional Sponsorship offset Projects	0	(0.5)		
Total	3200	2.8		
Total CO_2 emissions following Mitigation Options and additional reduction options			3.6	4.6

PROVINCE OF NEW BRUNSWICK
BOARD OF COMMISSIONERS OF PUBLIC UTILITIES
Direct Evidence of Mr. Stewart MacPherson
Coleson Cove Refurbishment Project

Q11. What options are available to NB Power to control and reduce greenhouse gas emissions, specifically CO_2?

Refurbishment of Point Lepreau would prevent a 20-40% increase in CO_2 emissions (assumes the lost energy would have to be replaced by natural gas combined cycle generation or coal-fired generation, respectively).

Retirement of the 60 MW Grand Lake Plant in 2004 will reduce CO_2 emissions by about 1.5%.

NB Power's load forecast calls for significant incursion by natural gas into existing and future space heating markets. It also calls for self-generation by industry (probably using natural gas) which will displace 150 MW of firm industrial load. These measures are equally important in helping to stabilize CO_2 emissions at current levels.

To reduce CO_2 emissions, additional steps will have to be taken.

This Board has asked NB Power to investigate and present further evidence on the potential for additional demand side options at the Lepreau refurbishment hearing. Their contribution to CO_2 reduction will be presented as well.

A Study is underway to assess wind conditions in the Lameque area as part of a review of the potential for wind generated electricity.

While limited in number, there are some potential small hydro developments left in New Brunswick. NB Power supports the Market Design Committee in its work to eliminate barriers for such developments.

To put these options in perspective, 50 MW of small hydro and 50 MW of wind generation would reduce CO_2 emissions by about 3.0%. The CO_2 reduction value of increased energy efficiency or conservation would depend upon the type of energy usage that is reduced because different uses are at different capacity factors (30% for space heating, 50% for lighting, 90% for industrial motors, etc.). Based upon a composite rate of 40%, 50 MW of reduced energy use, if achievable, would lower NB Power's CO_2 emissions by about 1.5%.

Electricity from Orimulsion® is similar in variable cost to electricity from coal but produces lower CO_2 emissions. Consideration of this emission advantage to dispatch Orimulsion® before coal could cost effectively reduce NB Power's CO_2 emissions by 3 to 5%.

Increased use of combined cycle natural gas generation, particularly co-generation projects, would also help contain and possibly reduce CO_2 emissions on a regional basis. The generators could be located anywhere within the region and it doesn't necessarily have to be New Brunswickers that pay the higher costs of the gas option. I am concerned that significant implementations of CO_2 reduction requirements could drive natural gas prices even higher.

NB Power is also monitoring other potential options such as sequestration of CO_2 in depleted natural gas wells in Western Canada. Greenhouse gas emissions are a global issue and these types of potential solutions may prove effective and efficient as part of Canada's response. Utilities and other companies in Eastern Canada could help fund these solutions if viable and be credited with a share of the sequestration.

Q12. Couldn't NB Power also reduce its CO_2 emissions by reducing export sales?

Yes. It is an option that we are evaluating.

As I stated earlier, export sales keep power rates 10-15% lower then they would otherwise be. Reduction of export sales will correspondingly remove this advantage and increase rates.

Our intention is to pursue the least cost means of CO_2 reduction. If we are able to redispatch generation at a lower cost per tonne of CO_2 we would do that first. Next we may only need to reduce the least profitable exports.

We also support the development of an extended trading mechanism for CO_2 reduction credits. A regional one is intended to be pursued by the New England Governors and Eastern Canadian Premiers but we believe that it should be extended across all of North America or more. Such a system would promote the most economical methods of CO_2 reduction. It would enable us to sell cost effective reduction credits if we had a surplus and to buy reduction credits if they are lower cost than our reduction alternatives.

Mr. Marshall will present evidence which outlines the potential for CO_2 reduction from different sources including reduced exports and emission trading.

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2.4.3 Carbon Dioxide (CO_2) Emissions

Climate change is an important global issue and countries around the world are working together to meet this challenge. In December 1997, Canada and some 160 countries tentatively agreed to the Kyoto Protocol, in which industrialized countries undertook to reduce their collective emissions of greenhouse gases. Canada's target is to reduce its greenhouse emissions to 6 percent below 1990 levels between 2008 and 2012. In 2001 the Bush Administration withdrew the United States from the Protocol and Canada has yet to ratify it. Negotiations have been ongoing toward a softened agreement but nothing is yet final.

In August 2001, Eastern Canadian Premiers and New England Governors developed a climate change action plan that addressed several action items including the reduction of greenhouse gases from the electricity sector. The key goal of this specific action item is to stabilize emissions at 1990 levels by 2010 and to target reductions of 20% (note – this should be 10%) for 2020. The targets are across the region in general and do not apply to individual provinces and states. Implementation of targets only in this region is expected to be controversial and difficult unless most other regions in North America adopt similar plans. In addition to reduction targets, the plan calls for the creation of a regional registry and the exploration of a trading mechanism. NB Power supports a trading mechanism but sees it as only a first step. Because climate change is a global issue the trading region must be much larger than the New England and Eastern Canada region.

The emissions of CO_2 for which NB Power is accountable in 1990 is 8.3 million tonnes. For this study emissions are reported for all development plans under different sensitivity conditions. In addition an environmental emission trading sensitivity analysis is included to quantify the impact of trading on the economics of the different alternatives.

4.3.7 Environmental Emission Costs for CO_2, SO_2 and NOx

Inherent in the resource planning process are environmental regulations which impose constraints that must be considered in developing a least cost resource plan. As such, NB Power operates and plans within these constraints. As mentioned in Section 2.3 Environmental Constraints, the existing regulations are met through adequate engineering design, and other than their influence on the cost of the specific project, they do not influence the planning process because these costs are internalized.

Currently there is increased development and support for economic instruments to help control environmental emissions. The US currently has an active trading system for SO_2 emissions, Ontario is introducing trading systems for SO2 and NOx and there are various pilot systems operating or in development for CO_2. Assuming that these systems continue to develop and include New Brunswick, they will place a potential value or cost on the varying emissions of the different alternative expansion plans. To account for the emission differentials from targeted system emission limits, the emission cost values below were applied for each effluent. The values are expressed in 2006$ and are based on current market projections and mitigation costs.

SO_2 \$200 per Tonne
CO_2 \$15 per Tonne
NOx \$2000 per Tonne

The results of this Environmental Emission Cost Sensitivity are provided in Table 4-13. It shows that inclusion of emission cost values does not influence the resource option mix of the Orimulsion® plan or either alternative plan. The net present value advantage of the Orimulsion® plan is reduced but it is still significantly lower cost than the oil blend plan and the oil blend/natural gas combination plan.

Table 4-13

Environmental Emission Costs Sensitivity Analysis

In Service Date	Orimulsion® Conversion	Oil Blend	Oil Blend/Natural Gas Combination
2004/5	CC#1, #2, #3-Orm		
2005/6		CC#1, #2, #3-Blend	CC#1, #2, #3-Blend
2006/7	Short Term Purchases	Short Term Purchases	400MW NGCC
2007/8	Lepreau Retube	Lepreau Retube	Lepreau Retube
2008/9			
2009/10			
2010/11			
2011/12			
2012/13			
2013/14			
2014/15			
2015/16	100MW CT		
2016/17	100MW CT	400MW NGCC	
2017/18	100MW CT		
2018/19			
2019/20	100MW CT		
Differential Net Present Value		$384 Million	$436 Million

4.4 Stress Case Evaluation

The sensitivity analyses provided indicate that the Orimulsion Conversion plan for Coleson Cove is a robust plan that is least cost for a wide range of potentially changing conditions. However each sensitivity assumes that each change from the base case occurs one at a time and for different single changes the cost advantage of the Conversion plan narrows. This Stress Case is developed to consider the impact on expansion plans for multiple changes from the Base Case that may work against Conversion. Included in the Stress Case are:

- Low gas prices
- Low export market conditions
- No load growth beyond 2010
- Environmental emission costs for SO_2, NOx and CO_2

The expansion plans and net present value costs for this Stress Case analysis are given in Table 4-14. No capacity additions are required for any plan beyond 2008. Results show that Orimulsion® Conversion remains the least cost but by a reduced margin.

Table 4-14

Stress Case Analysis

In Service Date	Orimulsion® Conversion	Oil Blend	Oil Blend/Natural Gas Combination
2004/5	CC#1, #2, #3-Orm		
2005/6		CC#1, #2, #3-Blend	CC#1, #2, #3- Blend 400MW NGCC
2006/7	Short Term Purchases	Short Term Purchases	
2007/8	Lepreau Retube	Lepreau Retube	Lepreau Retube
2008/9			
Differential Net Present Value		$76 Million	$173 Million

4.5 Environmental Emissions

Meeting expected system limits for SO_2 and NOx is the key driver of change in the operation of Coleson Cove. The Orimulsion® Conversion project and the alternative plans have all been designed with these emission limits in mind. However, each plan produces different levels of emissions as shown in Figure 4-1.

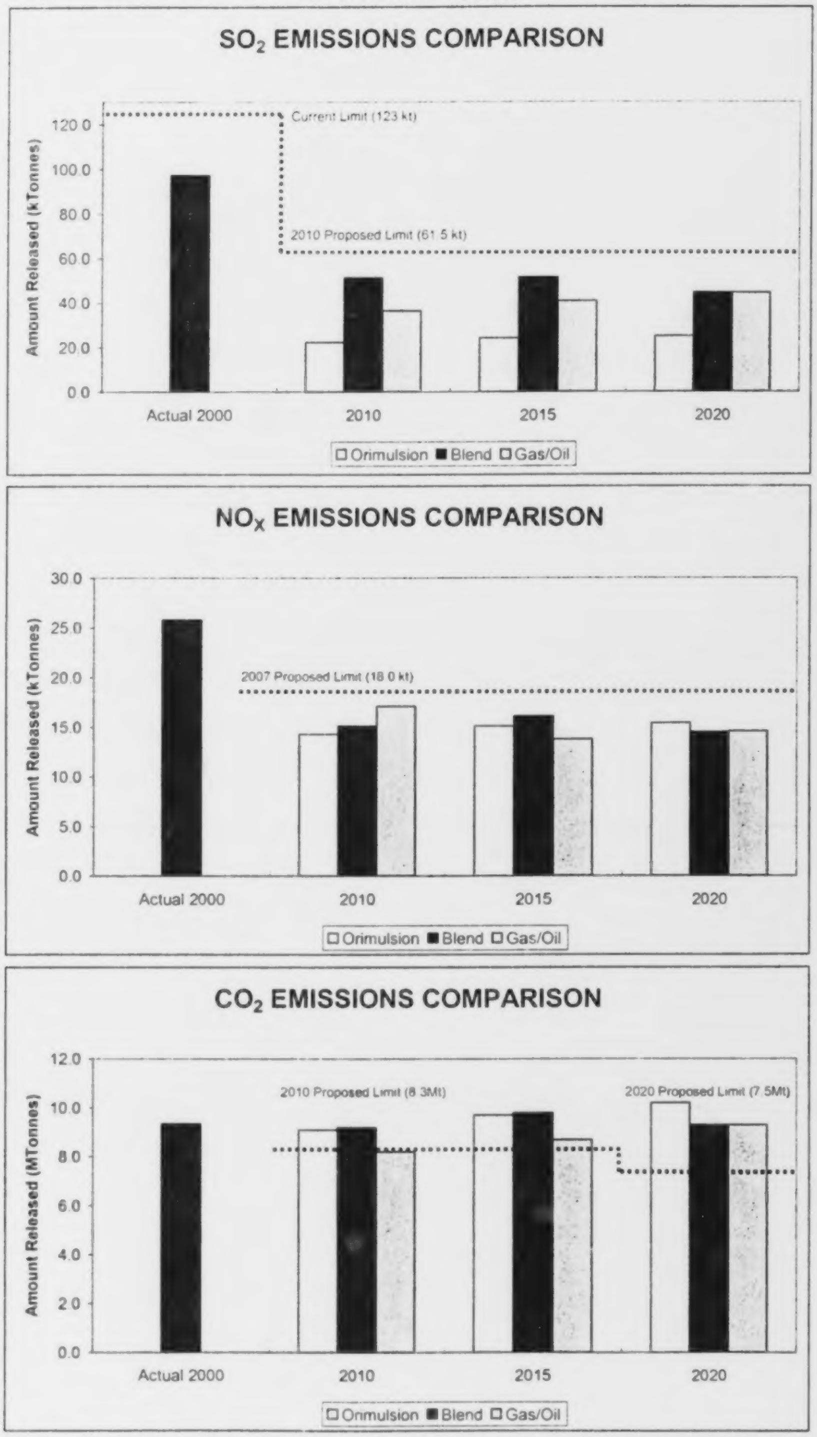
Emissions of SO_2 and NOx are significantly reduced from actual Year 2000 emissions in all expansion plans. The Orimulsion® Conversion plan by far has the lowest SO_2 emissions for both 2010 and 2020. Its NOx emissions are the lowest for 2010 but are slightly higher in 2020. All plans keep emissions below the expected limits which are shown as dotted lines on the different graphs.

The issue of CO_2 emissions has not been specifically addressed in the design of the expansion plans. As shown in Figure 4-1 future emissions are lower than Year 2000 levels but none of the plans produce CO_2 emissions that are below the CO_2 emission targets of the New England Governors and Eastern Canadian Premiers. Their targets are stabilization at 1990 baseline emissions by 2010 and a 10% reduction of 1990 emissions by 2020. The Governors and Premiers are targeting regional limits and provision is to be made for a CO_2 emission trading system within the region. Such a system would promote the most economical methods of emission reduction. It would enable NB Power to sell cost effective reduction credits if it had a surplus or to buy reduction credits if they were lower cost than NB Power reduction alternatives. Similar trading markets already exist in the US for SO_2 and NOx.

The Emission Cost Sensitivity given in section 4.3.7 models the working of emission trading markets under the assumption that the emission cost values employed are the market trading values. In that sensitivity not only were the emission values used to cost the differential emissions between plans. They were also included with fuel costs so that the resulting generating dispatch did not just minimize fuel costs but rather minimized the cost of fuel plus emissions.

Figure 4-2 illustrates the resulting emissions for the Emission Cost Sensitivity. There is little change in SO_2 and NOx emissions in any of the plans when compared to those emissions in the base case. But the emission cost redispatch does alter CO_2 emissions. In 2010 the oil blend/natural gas combination plan emissions reduce to below the target level and the Orimulsion® Conversion emissions reduce to just above the target level. Oil blend emissions do not vary. In 2015 the comparative pattern between plans is the same and all plans reduce CO2 emissions by about 0.3 million tonnes.

Figure 4-1
Base Case Emissions



In 2020 in Figure 4-2 the oil blend and oil blend/natural gas combination plans are essentially identical (the oil blend plan added a combined cycle unit in 2016) and redispatch improves their position relative to Orimulsion®. However, all plans in 2020 are well above the Governors and Premiers target.

In addition to emission cost redispatch CO_2 emissions could be reduced by a number of measures. Emission free resources like wind and small hydro, energy conservation and sequestrations could potentially be implemented prior to 2020. A major option for NB Power is the reduction of export sales. It is NB Power's intention to pursue the least cost means of CO_2 reduction. Lowest cost redispatch and least profitable export sales would be done first. These should be able to be accomplished at the $15/tonne CO_2 cost modeled as it is based on this type of NB Power mitigation strategy. If emission trading exists the net cost to NB Power to achieve the targets would go down because reduction credits could be purchased from the market if lower cost than $15/tonne or sold if the market price is higher than $15/tonne.

The Stress Case provided in Section 4-4 is illustrative of the capability of the NB Power system to deal with CO_2 emissions. Its low exports and emissions cost dispatch reflect what could be done in combination with a trading system. The zero load growth beyond 2010 reflects the potential for conservation and energy efficiency measures and emissionless wind and hydro generation. Figure 4-3 illustrates emissions for the Stress Case which shows that all plans are capable of meeting all projected emission targets. The highest emissions occur in the oil blend plan for all emission types while the oil blend/natural gas combination plan has lower CO_2 but equivalent SO_2 and NOx emissions compared to the Orimulsion® plan.

Figure 4-2
Emission Cost Sensitivity Emissions

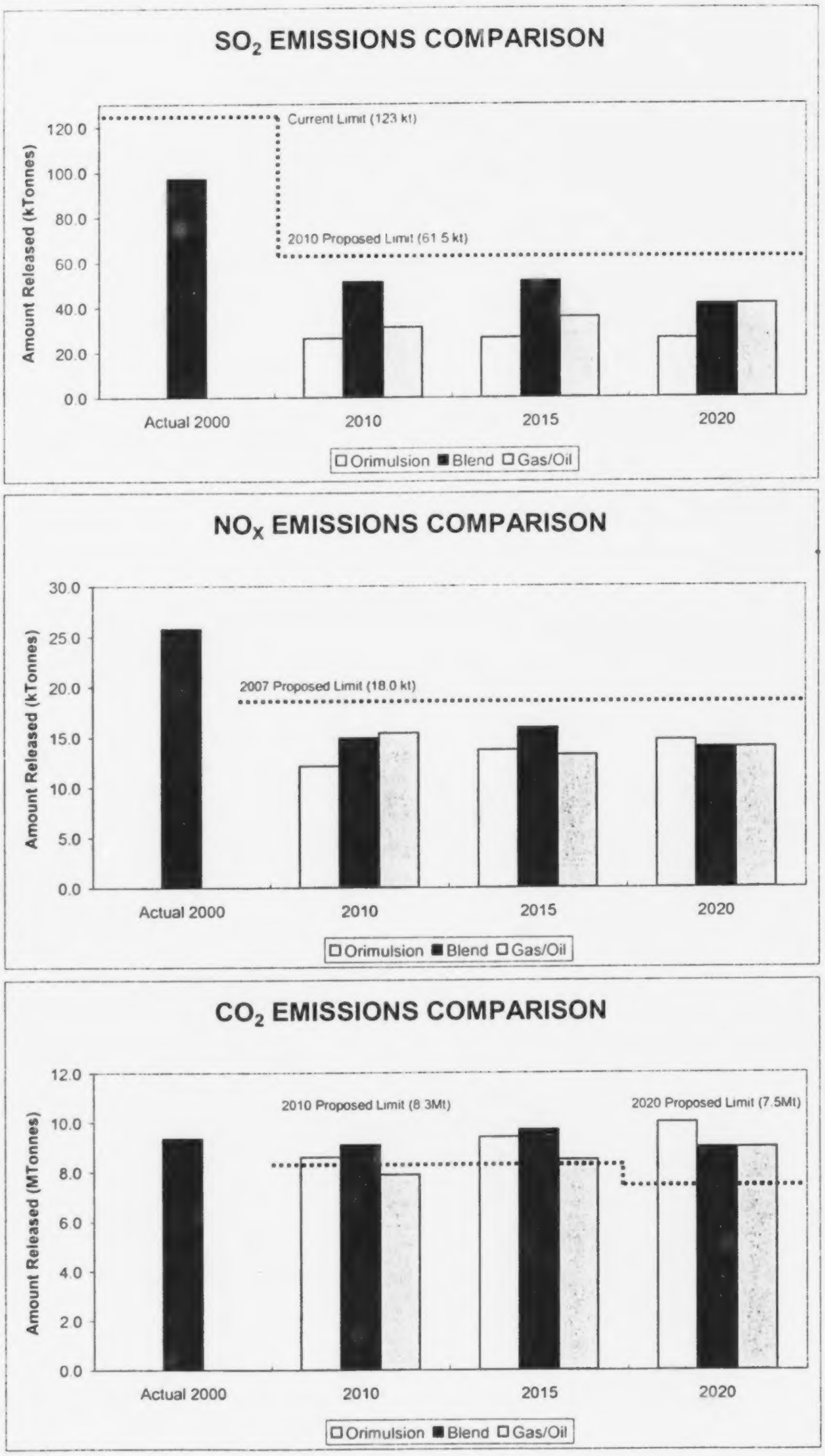
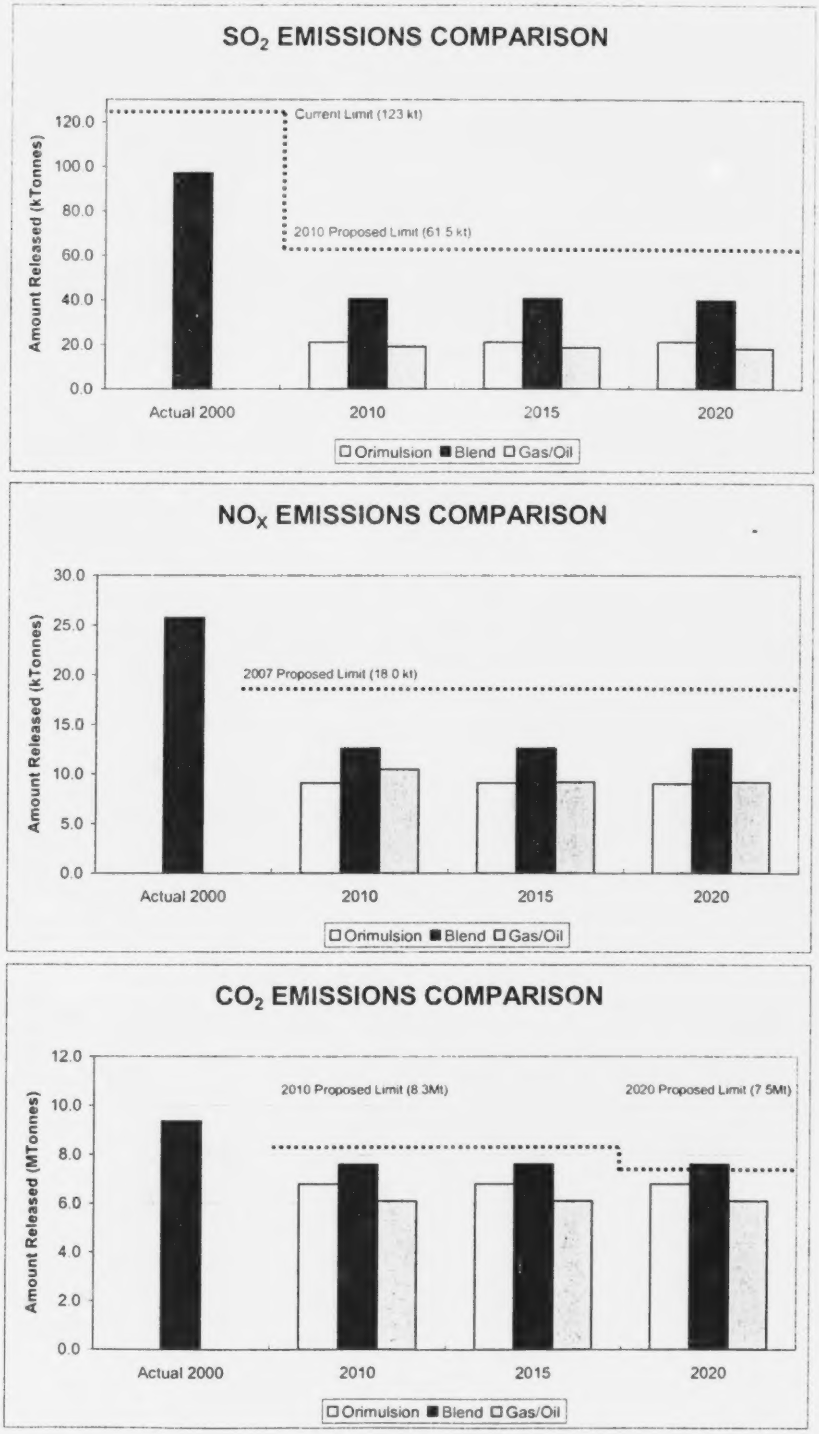


Figure 4-3

Stress Case Emissions



4.6 Conclusions

Based on the evaluations done in this study the following conclusions are made regarding the future resources development for NB Power.

- Orimulsion® Conversion is the least cost expansion plan for a base case forecast of future conditions.
- Orimulsion® Conversion is the least cost expansion plan for a wide range of sensitivity variations.
- Orimulsion® Conversion is the least cost expansion plan for a stress case that assumes rigorous implementation of emission limits.

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Point Lepreau Evaluation
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February 2002

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4.5 CO_2 Mitigation Plan

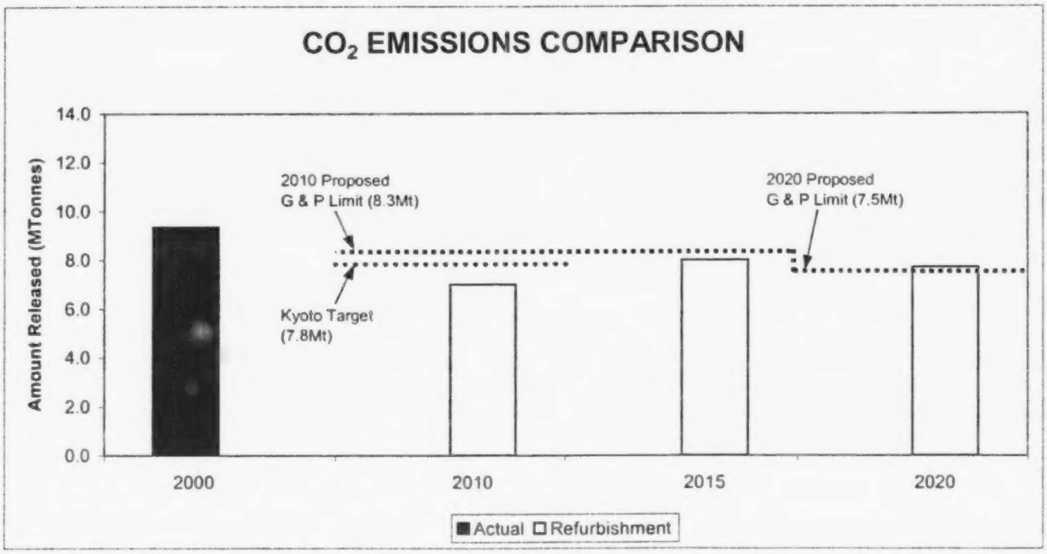
As shown in the CO_2 emissions chart for the Base Case (Figure 4-1), Point Lepreau Refurbishment reduces CO_2 emissions by at least 2.0 million tonnes compared to other alternatives. As a result, Refurbishment is a key element of NB Power's CO_2 emissions mitigation strategy. But Point Lepreau Refurbishment alone is not sufficient. Other elements of the strategy are renewable energy from Wind and Hydro, DSM, redispatach of low emission generation and reduction of low margin exports.

In the PUB hearing on Coleson Cove Refurbishment it was shown that NB Power could reduce CO_2 emissions below the 2008 to 2012 target of Kyoto (7.8 million tonnes) and the 2010 target of the New England Governors and Eastern Canadian Premiers (8.3 million tonnes). Achievement of these targets could be done unilaterally by reducing low margin export sales (1.5 TWh) and by re-dispatch of lower emission generation. This combination could achieve reductions of about 1.5 million tonnes at a cost of $15/tonne.

In this study the $15/tonne has been applied as the emission cost for CO_2 and it has been incorporated into the PROVIEW modeling. Resulting from this analysis is the expansion plan given in Table 4-2 with DSM, Hydro and Wind. Reduction in emissions attributable to re-dispatch also included in the Base CO_2 Case emissions chart (Figure 4-2). To achieve the additional emission reductions attributable to the 1.5 TWh lowering of low margin exports the Base CO_2 Case was modeled again with adjustments to account for the lower exports. The resulting expansion plan is identical to the Base CO_2 Case plan and the resulting CO_2 emissions are given in Figure 4-4.

The figure shows that CO_2 emissions are below the lower Kyoto limit in 2010. Concerning the Governors and Premiers limits, emissions are below the 2010 limit in both 2010 and 2015 and are marginally higher in 2020. To achieve the additional reduction required in 2020 some higher margin exports would need to be foregone or CO_2 credits would need to be acquired. These credits could be achieved directly in New Brunswick by purchase of energy from outside New Brunswick such that internally generated emissions would be reduced. Alternatively the credits could be purchased through emissions trading mechanisms. Because the quantity of credits that may need to be purchased is very small it should be able to be done within any potential trading restrictions.

Figure 4-4
CO_2 Mitigation Plan Emissions



4.6 Conclusions

Based on the evaluations done in this study the following conclusions are made regarding the future resources development for NB Power:

- Refurbishment of Point Lepreau is the least cost expansion plan for forecast future conditions, both with and without the inclusion of CO_2 mitigation costs.
- Refurbishment of Point Lepreau is the least cost expansion plan for a wide range of sensitivity variations especially when mitigation of CO_2 costs were included.
- Refurbishment of Point Lepreau is required as a key element of NB Power's strategy to mitigate CO_2 emissions and meet projected CO_2 limits.

APPENDIX F

Concordance Table

Concordance Table

NBDELG GUIDELINES	Coleson Cove Refurbishment Project EA
Executive Summary	Page i - Executive Summary
Introduction	Section 1.0 – Introduction
Application of Regulation 87-83	Section 1.2.1 – General Considerations
Scope of the Project	Section 1.3 Scope of Coleson Cove Refurbishment Project
Scope of the Environmental Assessment	Section 1.3.5 Scope of Assessment Overview of Final Guidelines
Cumulative Effects Assessment	Section 2.3.2 Cumulative Effects Assessment
Purpose and Description of the Project	Section 4.0 Project Description
• The fuel delivery, offloading, storage and transportation systems	Section 4.3.1 Fuel Delivery and Storage
• Properties of the Orimulsion® fuel and its behaviour in the marine environment.	Section 4.2 Orimulsion® Section 4.2.2 Behaviour in the Environment
• The modifications and additions to the existing infrastructure at the generating station.	Section 4.3 The Proposed Project
• Transportation, handling and storage systems of additives, such as limestone, used in the project.	Section 4.3.6 Material Handling
• Transportation, handling and storage systems of by-products from the project.	Section 4.3.6 Material Handling
• The construction methodology and design description for the wastewater treatment and landfill systems.	4.3.7 Solid Waste Storage and Disposal Area
• Upsets of environmental control equipment from future operations of the facility which may change the nature of emissions and/or effluent.	Section 4.10.4 Alternative Pollution Prevention Technologies
Study Boundaries	Section 2.2 Boundaries, Section 7.0
• Temporal	Section 2.2 Boundaries
• Spatial	Section 2.2 Boundaries
Project Rationale	Section 4.9.2 Alternative Projects and Fuels
Identification and Analysis of Alternatives	Section 4.9 Alternatives
• Null Alternative	Section 4.9.1 No Project

Concordance Table

NBDELG GUIDELINES	Coleson Cove Refurbishment Project EA
• Alternative Fuels	Section 4.9.2 Alternative Project and Fuels
• Alternative Fuel Delivery Options	Section 4.9.3 Alternative Fuel delivery Options
• Alternative Pollution Prevention and Control Measures.	Section 4.9.4 Alternative Pollution Prevention Technologies
Description of Existing Environment	Section 5.0 Environmental Setting
• Coastal, climatic and oceanographic data	Section 5.3.2 General Hydrology Section 5.3.3 Hydrography
• Topography	Section 5.4.1 Physiography and Geology
• Geology	Section 5.4.1 Physiography and Geology
• Hydrogeology	Section 5.4.2 Hydrology and Hydrogeology
• Surface water	Section 5.4.2.1 Surface Water Quantity Section 5.4.2.2 Surface Water Quality
• Groundwater	Section 5.4.2.3 Groundwater Quantity Section 5.4.2.4 Groundwater Quality
• Current and potential marine and land use	Section 5.7.3 Existing Marine and Land Use
• Marine vessel traffic	Section 7.3 Marine Ecosystem
• Terrestrial environmental components	Section 5.4 Terrestrial Environment
• Wetlands	Section 5.4.3 Wetland Resources
• Freshwater and marine aquatic biological components (including fish, fish habitat and fisheries resources)	Section 5.5 Fish Habitat and Fisheries Resources
• Rare and endangered species and their habitats	Section 5.4.4.2 Plant Species at Risk Section 5.4.5.1 Mammals – Mammal Species at Risk Section 5.4.5.2 Birds – Bird Species at Risk Section 5.4.5.3 Herpetiles – Herpetile Species at Risk Section 5.5.1 Fish Species at Risk
• Ecologically sensitive or significant areas	Section 5.6 Designated Areas and Other Critical Habitat Features
• Archaeological resources	Section 5.9 Heritage and Archeological Resources Section 7.6.1.6 Archeological/Heritage Resources

Concordance Table

NBDELG GUIDELINES	Coleson Cove Refurbishment Project EA
• Air quality, including acidification chemistry in precipitation	Section 5.2 Atmospheric Environment
• Local economy	Section 5.7.2 Industry and Commerce
• Current and foreseeable land use and zoning restriction	Section 4.8 Other Projects
• Existing public health and safety concerns	Section 5.7.4 Existing Public Health and Safety Concerns
• Ambient noise levels (near potentially affected habitation)	Section 5.7.5 Noise
• Transportation (traffic volumes and types)	Section 5.7.3.8 Transportation Infrastructure
• Current emission and effluent volumes and characteristics	Section 5.2.2 Ambient Air Quality, Section 4.1.3
• The potential for encountering contaminated soils	Section 5.4.1.7 Soils; Section 7.4.2.1 Fish Habitat
• The integrity of the existing fuel oil pipeline	Section 7.4.2.2 Wetland - Operations
• The integrity of any other infrastructure used for fuel delivery	Section 7.4.1 Scope of Assessment- Likely Future Developments Section 4.3.1 Fuel Delivery and Storage – CCGS Fuel Storage and Delivery
Scoping of VECs	Section 6.0 Valued Environmental Components
• VEC Identification	Section 6.3.1 Valued Environmental Components VEC Descriptions
Impacts on Air Quality	Section 7.2 Air Quality
• Impact predictions air pollutants of various components of Project.	Section 7.2.2.1 Methods – Source Analysis
• Ability of Project to meet or exceed emission standards	Section 7.2.1.2 Methods – Facility Emissions
• Feasibility and options available to adapt facility to achieve potential future commitments	Section 4.9.4 Alternative Pollution Prevention Technologies
• Documentation from similar operations to meet standards.	Section 4.9.4 Alternative Pollution Prevention Technologies
• Air quality monitoring options and feasibility	Section 7.2.3 Air Quality Monitoring
• Prediction of ground-level concentrations of air contaminants	Section 7.2.2.1 Methods – Ground Level Effects
• Climatology of the area (micro and macro climatology effects)	Section 7.2.1.2 Baseline – Meteorology

Concordance Table

NBDELG GUIDELINES	Coleson Cove Refurbishment Project EA
• Option for near and long term reduction of GHG and regional commitments for the electricity sector under NEG/ECP Climate Change Action Plan	Section 7.2.1.1 Assessment Boundaries Section 7.2.1.3 Likely Future Conditions
• CO_2 reductions from Kyoto agreement	Section 7.2.1.3 Likely Future Conditions Section 7.9 Cumulative Effects – Climate Change and Global Warming
• Identify any increased impacts on health or the environment and any programs to offset increases.	Section 7.6 Human Health Risk Assessment
• Mitigations	Section 7.2.3 Air Quality Monitoring – Mitigation
• Cumulative Effects	Section 7.2.3 Air Quality Monitoring; Section 7.9 Cumulative Effects
Impacts on Surface and Groundwater	Section 7.4.2.1 Fish Habitat
• Impact of construction, operation, and maintenance on surface and groundwater quality	Section 4.4 Construction Section 4.5 Operation Section 4.6 Decommissioning
• Impacts of potential deterioration in water quality on VEC's	Section 7.4.2.1 Fish Habitat
Impacts on the Bay of Fundy	Section 7.3 Marine Ecosystem
• Predict risk to VEC's (inc. Right Whale) from a spill during transportation and offloading procedures.	Section 7.7.4 Biodiversity and Sustainability Assurance Section 7.3.7.1 Comparative Ecological Risk Assessment
• Comparison to Fuel Oil #6 spill	Section 7.3.7.1 Comparative Ecological Risk Assessment
• Economic consequences of a spill	Section 7.5.3 Economic Consequences of a Marine Traffic Incidence
• Response Organization(s) responsible in the event of a spill.	Section 4.7 Safety and Contingency Planning
• Financial Liability of a contingency event.	Section 4.7 Safety and Contingency Planning
• Spill prevention and spill response plan for marine and on land.	Section 4.7 Safety and Contingency Planning
• Explanation of Management of Vessel traffic in Bay of Fundy	Section 7.3.1.2 Baseline - Description of Existing Vessel Traffic
• Overview of the TERMPOL Process (TP 743E) for fuel delivery portion.	Section 1.2.2 TERMPOL Review Process
• Mitigations	Section 7.3.9 Mitigation

Concordance Table

NBDELG GUIDELINES	Coleson Cove Refurbishment Project EA
• Cumulative Effects	Section 7.3.8 Cumulative Effects Assessment
Transportation Issues	Section 5.7.3.8 Transportation Infrastructure
• Impacts of increased ground transportation in region	Section 7.2.3 Air Quality Monitoring
• Noise, safety, risks of spills and air quality issues.	Section 5.7.5 Noise Section 5.7.4 Existing Public Health and Safety Concerns
• Localized impacts of fossil fuel combustion as a result of inc. traffic.	Section 7.2.3 Methods – Vehicle Emissions
Socioeconomic Impacts	Section 7.5 Impacts on Socioeconomic Environment
• Impact of large storage tank at Pier 10	N/A
• Human health analysis	Section 7.6 Human Health Risk Assessment
• Socioeconomic benefits and costs	Section 7.5.1 Socioeconomic Benefits; Section 7.5.7 Economic Consequences of the Project
• Sources and characteristics of potential risks to workers during construction and operation	Section 7.5. 2 NB Power Health and Safety Program, and Performance Statistics
• Ability to Harmonize with 2001 NB Energy Policy	Section 7.5.2 New Brunswick Energy Policy Paper
• Cumulative Environmental Effects	Section 7.9 Cumulative Environmental Effects
Impacts on Terrestrial and Wetland Environments	Section 7.4 Terrestrial, Wetland and Freshwater Assessment
• Impacts related to operation and construction on archeological resources	Section 7.5.4 Archaeological/Heritage Resources
• Impacts related to operation and construction on neighbouring properties	Section 4.3.10 Land Acquisition and Site Improvements
• Impacts on Saints Rest Marsh	Section 7.4.2.2 Wetlands – Operations
• Integrity of 30 year old existing pipeline.	Section 7.4.2.2 Wetlands – Operations; Section 4.3.1 Fuel Delivery and Storage
• Mitigation	Section 7.4.2.1 Fish Habitat – Mitigation Section 7.4.2.3 Terrestrial Habitat – Mitigation Section 7.4.2.4 Species at Risk - Mitigation

Concordance Table

NBDELG GUIDELINES	Coleson Cove Refurbishment Project EA
• Cumulative Effects	Section 7.4.2.1 Fish Habitat – Cumulative Effects on Fish Habitat Section 7.4.2.2 Wetlands – Cumulative Effects Section 7.4.2.3 Terrestrial Habitat – Cumulative Effects
Cumulative Effects	Section 7.9 Cumulative Effects
Public Consultations	Section 3.0 Public Consultation
Contingency and Compensation	Section 4.7 Safety and Contingency Planning
Monitoring and Follow-up	Section 8.0 Environmental Monitoring and Follow-up Programs
• Mapping of facility with monitoring components	Section 4.3.8 Freshwater Supply System, Figure 4.4
• Monitoring data for last five years (air quality)	Section 7.2.1.2 Baseline – Ambient Air Quality
• Effluent quality	Section 4.3.6 Material Handling
• Leachate quality	Section 4.3.6 Material Handling
• EEM monitoring/long term trends and interpretive reports	Section 8.1.1 Mitigation; Section 4.1.3 Existing Wastewater System
• Well defined monitoring program	Section 8.0 Environmental Monitoring and Follow-up Programs